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## A Revision of the Bees of the Genus *Melissodes* in North and Central America. Part III (Hymenoptera, Apidae) \*

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**ABSTRACT:** This is the third and last part of a monographic revision of the bee genus *Melissodes* in North and Central America. Eighty-five species belonging to two subgenera are described. One subgenus, *Callimelissodes*, is newly described. Thirty-nine new species are described:

*Melissodes limbus*, *M. lustra*, *M. pilicata*, *M. elegans*, *M. tincta*, *M. subilata*, *M. gelida*, *M. terminata*, *M. bicolorata*, *M. bimatrix*, *M. minuscula*, *M. hurdi*, *M. brevipyga*, *M. relucens*, *M. exilis*, *M. vernalis*, *M. utahensis*, *M. monoensis*, *M. nigracauda*, *M. comata*, *M. fasciatella*, *M. cerussata*, *M. fumosa*, *M. perpolita*, *M. paulula*, *M. expolita*, *M. pexa*, *M. micheneri*, *M. appressa*, *M. interrupta*, *M. lutulenta*, *M. ochracea*, *M. paucipuncta*, *M. plumosa*, *M. clarkiae*, *M. rufipes*, *M. pullatella*, *M. crocina*, *M. tribas*. Fifty-four names are relegated to synonymy and six names remain as *nomina dubia*. In an addendum, an additional new species, *M. haitiensis*, belonging to subgenus *Ecplectica* (treated in the first part of this revision, LaBerge, 1956) is described.

### INTRODUCTION

This is the third part of a revision of the bees of the genus *Melissodes* in North and Central America. The key to the subgenera of the genus *Melissodes* published in the first part of this revision (LaBerge, 1956) is repeated herein in modified form. A total of 30,095 specimens representing 86 species have been examined for this part of the revision.

Explanations of the methods used in describing the species, the meanings of certain descriptive terminology and methods used in taking certain measurements are described in a section on descriptive methodology in the first part of this revision (LaBerge, 1956,

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p. 919). No important changes in methodology have been introduced into this part of the revision.

The reader is also referred to the first part of this revision for a complete list of acknowledgements. I wish to thank the Society of the Sigma Xi for a Grant-in-Aid of Research which enabled me to travel in Europe during the summer of 1957 in order to study the type specimens now located in European museums. Certain persons have rendered special aid in comparing specimens, in graciously lending types in their care and in generously giving of their time and advice. I wish to especially thank the following persons for these services: Dr. I. H. H. Yarrow of the British Museum (Natural History), London; Mr. Karl V. Krombein of the United States National Museum, Washington, D. C.; Mr. P. H. Timberlake, Citrus Experiment Station, Riverside, California; and Dr. T. B. Mitchell, North Carolina State College, Raleigh, North Carolina. I am grateful to Dr. C. D. Michener of the University of Kansas, Lawrence, Kansas, for his interest and guidance throughout the period of preparation of this revision and for reading and commenting upon the manuscript.

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#### PHYLOGENETIC RELATIONSHIPS OF THE SUBGENERA

A diagram showing the relationships of the various subgenera of the genus *Melissodes* was published in the first part of this revision (LaBerge, 1956, p. 915). That diagram included three subgenera not now included in the genus *Melissodes* (*Brachymelissodes*, *Epimelissodes*, and *Idiomelissodes*, now in genus *Svastra* Holmberg). Also, the diagram did not include a subgenus subsequently recognized and described below (*Callimelissodes*). New characters have since been discovered which shed new light on the relationships of the subgenera now included in the genus. Therefore, a new analysis of these relationships is presented here.

From among the many characters found to be useful in the taxonomy of the genus *Melissodes* nineteen were chosen on the bases that they show variation among the subgenera and that the

primitive versus the specialized condition of each could be logically inferred. These characters and their primitive and specialized states are listed below.

*Primitive Characters*

1. Female sixth tergum with lamelliform, toothed lateral parts of gradulus.
2. Male with five-segmented maxillary palpi at least occasionally.
3. Male seventh sternum with lateral plates small, flat, hairy below.
4. Propodeum of female longer than metanotum medially.
5. Clypeus flat; mouthparts relatively short.
6. Male antennae long, first segment at most one-third as long as second segment.
7. Scopal hairs branched.
8. Galeae with hairs straight.
9. Galeae shiny or at most lightly shagreened.
10. Integument of mesoscutum shiny to shagreened.
11. Distal pale bands of terga 2 and 3 not apical or at least not completely so.
12. Male fifth sternum with apical margin straight to concave.
13. Male clypeus yellow or largely yellow or cream-colored.
14. Size of bee medium.
15. Female with distal pale band of tergum 2 present, interrupted or not, if interrupted or absent, band of tergum 4 also interrupted or absent.
16. Eyes converge towards mandibles.
17. Male flagellar segments without shiny elongate depressions.
18. Gonostylus with short, simple or barbed, diffuse hairs.
19. Male sternum 8 with simple or bidentate ventral tubercle.

*Specialized Alternatives*

1. Lateral parts of gradulus absent or cariniform.
2. Four- or three-segmented maxillary palpi.
3. Male seventh sternum otherwise.
4. Propodeum of female shorter or no longer than metanotum medially.
5. Clypeus more or less bowed out; mouthparts relatively long.
6. Male antennae short; first segment more than one-third of second.
7. Scopal hairs simple or weakly branched.
8. Galeae with hooked hairs.
9. Galeae dulled by dense tessellation.
10. Mesoscutum densely tessellate.
11. Distal pale bands of terga 2 and 3 apical.
12. Male fifth sternum convex medially to produced.
13. Male clypeus black or largely black.
14. Size small or large.
15. Female with distal pale band of tergum 2 absent or broadly interrupted while that of tergum 4 uninterrupted.
16. Eyes subparallel to converging towards vertex.
17. Flagellar segments with shiny elongate depressions.
18. Gonostylus with hairs long, simple, more or less concentrated near base on outer surface.
19. Male sternum 8 with strong medioventral crest.

All eight subgenera are specialized for all included species in at least two of these and primitive in at least ten of these characters. Each subgenus (except the monotypic *Psilomelissodes*) may have one or more species which is specialized in one or more characters, whereas the other species of the same subgenus are primitive for the same characters. Thus, for each character a subgenus may be primitive, partly specialized, or specialized. The subgenera and the number of the characters listed above are summarized in table I. In this table a specialized condition is represented by a plus sign, a primitive condition by a zero, and a partly specialized character by a dash. The number of each condition is tabulated for each subgenus at the bottom.

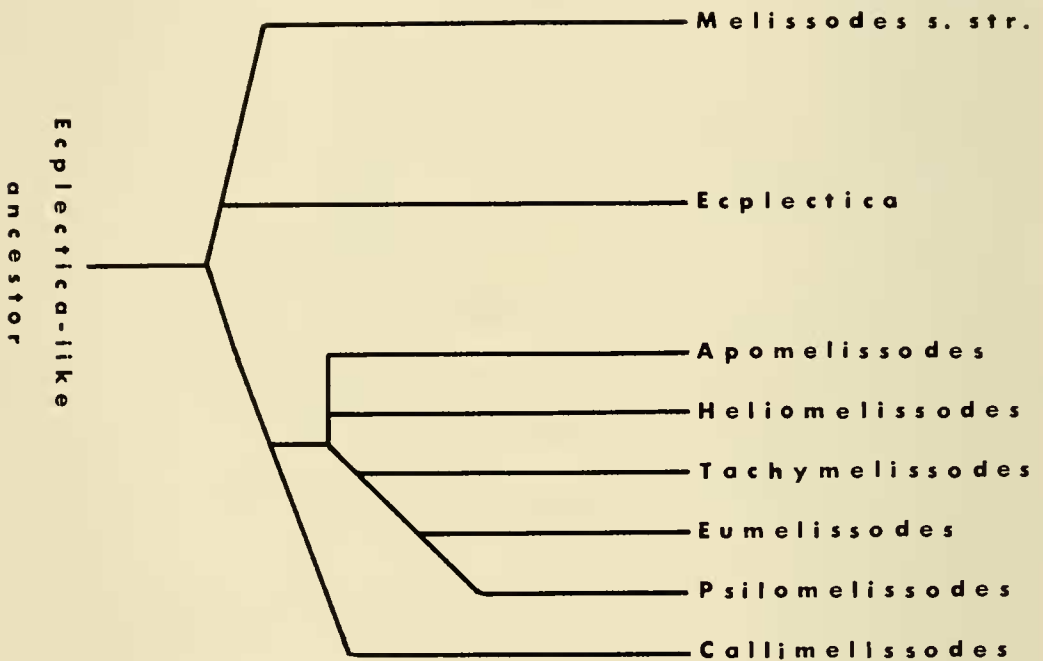


FIG. 2. Dendrogram showing the relationships of the subgenera of *Melissodes* Latreille. The lengths of the various lines are of no significance.

The phylogenetic diagram (Fig. 2) is based upon the above facts plus special consideration of the characters. An example of the latter is the dichotomy shown in the diagram between *Ecplectica-Melissodes* and the other subgenera. Although *Melissodes s. str.* appears specialized in more characters and at least as primitive as is the subgenus *Eumelissodes*, it is shown as having been derived from an *Ecplectica*-like ancestor independently of the *Eumelissodes* and the other subgenera. This dichotomy can also be seen in the list of characters given above. *Melissodes s. str.* has certain specialization of the male terminalia (characters 18 and 19) which can be more logically derived from the condition in *Ecplectica* than

TABLE I. Nineteen Characters of the Subgenera of *Melissodes*.

CHARACTERS BY NUMBER	Subgenera							
	Eclectica	Melissodes s. str.	Eumelissodes	Callimelissodes	Apomelissodes	Helimelissodes	Psilomelissodes	Tachymelissodes
1.....	0	0	+	+	+	+	+	+
2.....	+	—	—	+	+	+	+	+
3.....	0	+	+	+	+	+	0	+
4.....	+	+	0	0	0	0	0	0
5.....	0	0	0	0	+	+	0	0
6.....	0	0	0	0	0	0	+	+
7.....	0	0	0	—	—	0	+	0
8.....	0	0	—	—	—	0	0	0
9.....	0	0	—	—	0	0	0	0
10.....	0	—	0	0	0	0	0	0
11.....	0	0	0	0	+	0	+	+
12.....	0	0	0	+	0	0	0	0
13.....	0	0	—	0	—	—	+	—
14.....	—	—	—	—	0	0	0	+
15.....	+	0	0	0	0	0	0	0
16.....	0	0	0	0	—	+	0	0
17.....	0	0	—	—	0	0	0	0
18.....	0	+	0	0	0	0	0	0
19.....	0	+	0	0	0	0	0	0
Totals..... 0	15	12	11	10	10	13	13	12
—	1	3	6	5	4	1	0	1
+	3	4	2	4	5	5	6	6



from that in *Eumelissodes*. The condition of the same two characters in *Eumelissodes* can also be more logically derived from *Ecplectica* than from *Melissodes s. str.* Also, *Ecplectica* and *Melissodes s. str.* share a specialization (character 4) which separates them from the remaining subgenera and, vice versa, the remaining subgenera share a specialization (character 1) not yet acquired by the former two subgenera.

In spite of these considerations, the true phylogenetic picture could still be with a *Eumelissodes*-like ancestor giving rise to *Eumelissodes* and its related subgenera on one hand and to *Melissodes s. str.* through *Ecplectica* on the other hand. This hypothesis lacks the merit of having the evidence of primitiveness of the chosen phylogenetic arrangement. That is, the subgenus *Ecplectica* shows the primitive alternative in 15 of the 19 characters, whereas *Eumelissodes* is primitive in 11 of the 19 characters.

#### KEY TO THE SUBGENERA OF NORTH AND CENTRAL AMERICAN MELISSODES

The following key is an adaptation of that given by LaBerge (1956, p. 920). This key was modified by LaBerge (1956, p. 545) to include an additional species in the subgenus *Apomelissodes*. It is here further modified to omit those subgenera which have been removed from the genus *Melissodes* (e. g., *Epimelissodes*, *Brachymelissodes*, and *Idiomelissodes*) and to include the new subgenus described below (*Callimelissodes*).

The subgenera of *Melissodes* are extremely difficult to key, especially in the female sex. Therefore, some subgenera appear several times in the following key in order to include aberrant species. The males key out readily if one uses genitalic characters, otherwise certain subgenera must appear more than once in the key. The subgenera *Ecplectica* and *Melissodes* key out together in the female sex, partly because it is difficult to separate these subgenera in that sex and because in the original treatment of the species of these subgenera (LaBerge, 1956) the species are placed in the same key.

#### MALES

1. Clypeus protruding beyond eye from  $\frac{1}{2}$  to  $\frac{3}{4}$  width of eye in profile; metasomal terga 2-5 fringed with narrow marginal bands of appressed white pubescence, bands much narrower than basal areas; antennae long, minimum length first flagellar segment equals less than  $\frac{1}{3}$  maximum length second segment ..... *Apomelissodes*

- Clypeus usually not protruding beyond eye by as much as half width of eye in profile, *if* protruding by half width of eye or more, *then* minimum length first flagellar segments equals  $\frac{1}{2}$  or more of maximum length second segment; terga often not fringed by pubescent bands, but bands when present interrupted medially and/or subapical ..... 2
- 2 (1). Posterior margin of fourth and usually third sternum broadly convex, or produced into a broad, thin, hyaline, colorless flap ..... *Callimelissodes*
- Posterior margins of third and fourth sterna straight to slightly concave, never produced into a flap..... 3
- 3 (2). Clypeus strongly protruding beyond eye by  $\frac{3}{4}$  or more of width of eye in profile; maximum length first flagellar segment equals 0.4 or more of maximum length second segment ..... *Helimelissodes*
- Clypeus usually protruding half or less of width of eye in profile, *if* protruding more, *then* maximum length first flagellar segment less than 0.4 of maximum length second segment ..... 4
- 4 (3). Maximum length first flagellar segment as long as or almost as long as maximum length second segment and longer than third segment (antennae femalelike); clypeus wholly black ..... *Psilomelissodes*
- Maximum length first flagellar segment shorter than maximum length second segment and distinctly shorter than third; clypeus usually pale, occasionally partly or wholly black ..... 5
- 5 (4). Minimum length first flagellar segment distinctly more than half maximum length second segment; terga 2-5 with pubescent bands apical, subequal in width across each tergum and subequal in width to each other. *Tachymelissodes*
- Minimum length first flagellar segment half of maximum length second segment or less; terga 2-4 with pale pubescent bands usually not all apical or subequal in width, often interrupted medially and usually subapical..... 6
- 6 (5). Characters of genitalia and hidden sterna..... 7
- External characters ..... 9
- 7 (6). Median apical plates sternum 7 without hairs on ventral surfaces, usually small, curled ventrally along an oblique axis to form half or more of an oblique cylinder or scroll, but often secondarily flattened and expanded, or secondarily reduced in size ..... *Melissodes*
- Median plates sternum 7 thin, hyaline, with short to moderately long hairs on ventral surfaces, not curled ventrally, relatively large ..... 8
- 8 (7). Gonostylus short, less than half as long as gonocoxite, in lateral view twice as broad or more near base as near apex, narrowing abruptly near middle, not capitate; median

- plates sternum 7 relatively small, with several short hairs ventrally ..... *Ecplectica*
- Gonostylus short to long, usually as long as or longer than half length of gonocoxite, in lateral view not twice as broad near base as near apex, often somewhat capitate; median plates sternum 7 large, with abundant short to moderately long hairs ventrally ..... *Eumelissodes*
- 9 (6). Terga 2-5 without pale pubescent bands or these all interrupted medially, *if* one or two bands are complete, *then* thoracic hairs mostly black, or black and white mixed, and labrum all or almost all pale-colored ..... *Melissodes*
- Terga 2-5 usually with complete bands, occasionally one or more absent or interrupted medially, *if* with only one or two bands complete, *then* thorax bright ferrugineous hairs and labrum all or mostly all black ..... 10
- 10 (9). Labrum wholly pale; mandibles usually with basal yellow spots; last two metasomal terga with dark brown to black hairs ..... 14
- Labrum with at least a dark margin and mandibles often without pale basal spots, *or* last two metasomal terga with only pale hairs, *or* both ..... 11
- 11(10). Galeae smooth and shiny, without tessellation or shagreening except at tips ..... 12
- Galeae dulled by tessellation or shagreening at least in apical half ..... *Eumelissodes*
- 12(11). Last two terga with dark brown to black hairs ..... 13
- Last two terga with pale hairs only ..... *Eumelissodes*
- 13(12). Margins of terga 2-4 broadly hyaline, colorless or nearly so, *or* labrum entirely dark *or* pale spot covers less than half of surface, *or* both ..... *Eumelissodes*
- Margins of terga 2-4 opaque, black to reddish-brown; labrum mostly pale-colored, at most with narrow apical margin brown to black ..... *Melissodes*
- 14(10). Tergum 2 with distal pale band complete or only narrowly interrupted medially, *if* broadly interrupted, *then* basal pale band indistinct, consisting of diffuse pubescence or partly or wholly dark pubescence ..... *Melissodes*
- Tergum 2 with distal pale band absent or broadly interrupted medially, each fascia equal to  $\frac{1}{3}$  or less width of tergum, with basal pale band distinct ..... *Ecplectica*

## FEMALES

1. Scopal hairs simple or weakly branched, *if* weakly branched, *then* clypeus in profile protruding beyond eye by  $\frac{2}{3}$  width of eye or more; pygidial plate not narrow ... *Apomelissodes*
- Scopal hairs branched, usually abundantly so, *if* weakly branched, *then* clypeus in profile not protruding beyond eye by as much as  $\frac{2}{3}$  width of eye ..... 2
- 2 (1). Clypeus protruding anteriorly beyond eye in profile by  $\frac{1}{2}$  to  $\frac{2}{3}$  width of eye; inner orbits of eyes often parallel; inner sur-

- faces hind basitarsi with hairs dark brown to black (scopal hairs highly plumose, often yellowish) . . . . . *Helimelissodes*
- Clypeus protruding beyond eye by less than half width of eye in profile, *if* protruding as much as half width of eye, *then* inner orbits of eyes distinctly converging towards mandibles and/or inner surfaces of hind basitarsi with hairs bright red to yellow (scopal hairs occasionally weakly branched) . . . . . 3
- 3 (2). Scopal hairs weak, with few branches, not hiding outer surfaces of hind basitarsi and tibiae; metasomal terga very sparsely and weakly punctate, dulled by dense, fine shading and weakly banded with sparse pubescence and hairs; pygidial plate V-shaped with broadly rounded apex . . . . . *Psilomelissodes*
- Scopal hairs strongly branched and hiding outer surfaces of basitarsi and tibiae; or, *if* weak and with few branches, *then* terga coarsely punctate at least basally, or moderately shiny to shiny and strongly banded with abundant pubescence and hairs, *or* pygidial plate narrowly U-shaped . . . . . 4
- 4 (3). Scopal hairs with only one or two branches on each side of rachis; pygidial plate narrow, U-shaped . . . *Callimelissodes*
- Scopal hairs more highly plumose, most hairs with three or more branches on each side of rachis; pygidial plate variable, usually V-shaped with acute or well-rounded apex, 5
- 5 (4). Terga 2-4 with distal pale pubescent bands reaching apical margins of terga, of about same width across each tergum and subequal in width to each other, not arising from distinct punctures, as narrow or narrower than basal area of dark pubescence . . . . . *Tachymelissodes*
- Terga 2-4 with distal pale pubescent bands, or at least tergum 2, not reaching apices of terga, or, *if* reaching apices of terga, *then* diffuse over entire tergum or much wider than basal area of dark pubescence and/or not of about the same width across each tergum or subequal in width to each other; tergal punctures variable . . . . . 6
- 6 (5). Last flagellar segment as long as broad or slightly shorter, about equal to penultimate segment in length, *or*, small bees, 8-9 mm. in length with galeae with abundant long hooked hairs above or with sparse, extremely short, blunt, straight hairs and regular dense tessellation . . . *Callimelissodes*
- Last flagellar segment longer than broad and longer than penultimate segment; small to large bees, *if* small, *then* galeae either with abundant long straight hairs, or surface not densely tessellate, never small and with abundant hooked hairs . . . . . 7
- 7 (6). Sides of thorax and propodeum with black hairs; first tergum with sparse punctures above, medially restricted to basal third of tergum except a few widely scattered punctures; galeae shiny; terga 2 and 3 with interband zones with sur-



- faces dulled by fine, dense, reticulotransverse shagreening ..... *Callimelissodes*
- Sides of thorax and propodeum with pale hairs, or, *if* with dark hairs, *then* first tergum densely punctate above at least in basal half, and/or galeae dulled by shagreening or tessellation; occasionally terga 2 and 3 with interband zones with surfaces shiny, unshagreened..... 8
- 8 (7). First metasomal tergum with extremely sparse punctures restricted to basal third of tergum or less medially; *either* small to medium-sized bees with pygidial plate narrow, subparallel-sided and about twice as long as median width, *or* large bees with hairs of inner surface hind basitarsi black and of lower-lateral surfaces of thorax black, ..... *Callimelissodes*
- First metasomal tergum with punctures usually abundant at least in basal half, *if* sparse and restricted to basal third or less, *then* medium-sized bees with pygidial plate broadly V-shaped and much shorter than twice median width and lower-lateral surfaces of thorax without dark hairs ..... 9
- 9 (8). Large bees, wings deep brown, inner surfaces hind basitarsi with hairs dark brown, mesoscutum with large patch of dark brown hairs; head and thorax coarsely punctate, genal area near lateral margin of eyes with punctures round, deep, separated by about one puncture width or less, ..... *Callimelissodes*
- Size variable, *if* large, *then* wings not deep brown, *or* hairs of inner surface hind basitarsi yellow to red, *or* mesoscutum with at most small patch of brown hairs; head and thorax less coarsely punctate, genal area near lateral margin of eye with punctures usually minute, separated by much more than one puncture width..... 10
- 10 (9). Metasomal tergum 6 with postgradular carina with lateral parts lamelliform and ending abruptly in a short blunt tooth; pygidial plate narrow in apical half, often with sides subparallel (unless worn); tibial plate short, with edges exposed except anteriorly and on lower, anterior angle ..... *Callimelissodes*
- Metasomal tergum 6 with postgradular carina with lateral parts absent or at most cariniform, never with tooth; pygidial plate short, broad, not narrowed in apical half, not subparallel-sided; tibial plate larger, hairs cover edge anteriorly and at least on anterior half of lower margin (unless worn) ..... 11
- 11(10). Lateral and ventral surfaces of thorax with dark brown hairs (including propodeum); terga 2 and 3 with lateral raised areas of interband zones with large, irregular piliferous punctures, surfaces very shiny, with no tessellation or shagreening; supraclypeal area with surface smooth and shiny, unshagreened ..... *Eumelissodes*

- Lateral surfaces of thorax with pale hairs at least in some restricted area, *or* terga 2 and 3 with raised areas with surfaces at least delicately shagreened; supraclypeal area often dulled by shagreening or tessellation..... 12
- 12(11). Eye narrower than genal area in profile, widest part of eye equals half or less of length; lateral and ventral surfaces of thorax with black hairs.....*Eumelissodes*
- Eye wider than or equal to genal area in profile, widest part of eye usually equals more than half length, *or*, lateral surfaces of thorax with all or almost all hairs pale..... 13
- 13(12). Hairs of thorax all or almost all black; galeae shiny, without shagreening or tessellation, except at tips,  
*Melissodes* and *Ecplectica*
- Hairs of thorax largely pale, *or* galeae moderately shiny to dull due to shagreening or tessellation or both..... 14
- 14(13). Second flagellar segment longer than wide ventrally; inner surfaces hind basitarsi with hairs brown to black,  
*Eumelissodes*
- Second flagellar segment as long as wide or shorter, *or* inner surfaces hind basitarsi with hairs red to yellow, or both.. 15
- 15(14). Vestiture of metasomal terga entirely black or dark brown, except long hairs of first tergum and occasionally a thin median pale pubescent band on tergum 2; dorsum of thorax with rufescent to ochraceous hairs... *Eumelissodes*
- Terga with various amounts and arrangements of pale pubescence, never entirely dark except first and second terga, *or* dorsum of thorax with abundant dark hairs, or both.. 16
- 16(15). Metasomal tergum 3 *either* (a) with marginal area covered by pale pubescent band or nearly so (except median triangular notch less than  $\frac{1}{3}$  width of tergum), *or* (b) with an impunctate apubescent margin which either markedly narrows laterally from a median notch or is narrower than the pale pubescent band of tergum 2 across the entire tergum .....*Eumelissodes*
- Metasomal tergum 3 with (a) dark hairs apical to distal pale band across median third or more of tergum, *or* (b) with pale hairs in apical area not completely hiding surface and having fewer and shorter branches and more erect than those of distal pale band (note punctures when these are worn), *or* (c) with apical apubescent area wider than distal pale band of tergum 2 across entire tergum.. 17
- 17(16). Galeae above moderately shiny to dull, with shagreening or tessellation in at least apical half..... 18
- Galeae above smooth and shiny, without shagreening or tessellation except at tips..... 19
- 18(17). Metanotum medially as long as dorsal face of propodeum or longer; tergum 2 with distal pale band almost never interrupted medially, with straight anterior margin and evenly curved posterior margin; tergum 1 usually only narrowly hyaline or not at all, *if* broadly hyaline, *then*

- clypeus without large shiny median boss and inner surfaces hind basitarsi with hairs red to yellow.....*Melissodes*
- Metanotum medially distinctly shorter than dorsal face of propodeum, *or, either* distal pale band of tergum 2 interrupted medially or notched along posterior margin, *or* first tergum broadly hyaline, clypeus with large shiny median boss and inner surfaces hind basitarsi with hairs dark brown to black.....*Eumelissodes*
- 19(17). Dorsal face of propodeum usually without distinct punctures, irregularly rugose, occasionally with small scattered punctures apically but these obscured by dense tessellation and basal half to three-fourths irregularly rugose, *Eumelissodes*
- Dorsal face of propodeum with distinct punctures in at least apical half, ground areas tessellate but not so densely as to obscure punctures, basal half (or less) punctate or reticulorugose, not irregularly so ..... 20
- 20(19). Tergum 2 with distal pale pubescent band uninterrupted medially, evenly curved along posterior margin and of about the same width across tergum.....*Melissodes*
- Tergum 2 with distal pale pubescent band absent or interrupted medially, *or* not evenly curved along posterior margin but conspicuous notched medially..... 21
- 21(20). Tergum 2 with distal pale band absent or broadly interrupted medially, the lateral fasciae thus formed well separated from apical margin of tergum and each fascia no broader medially than half width of apical area,  
*Melissodes* and *Ecplectica*
- Tergum 2 with distal pale band at most narrowly interrupted and lateral fasciae thus formed each much broader than half width of apical area medially.....*Eumelissodes*

### *Callimelissodes*, new subgenus

*Type species. Melissodes lupina* Cresson, 1878.

This is a moderate-sized North American subgenus previously confounded with the subgenus *Eumelissodes* LaBerge by the author because of the lack of dependable female characteristics. *Callimelissodes* is predominantly a western North American subgenus containing fourteen species, only one of which extends in range east of the prairie states. The following description is in the style of that given by LaBerge (1956, p. 1177) for *Eumelissodes*.

*Female.* Small to large bees; integument generally black. *Clypeus* flat to slightly protuberant, never protruding beyond eyes by as much as half width of eye in profile; eyes converging toward mandibles, usually about three-eighths as broad as long, and in profile as broad as or broader than genal area; minimum length of first flagellar segment variable, in one species ultimate segment no longer than broad; *galeae* shiny and unshagreened to densely tes-



*sellate, usually with fine reticular shagreening, in one species with abundant long hooked hairs, less than one and one-half times as long as median clypeal length; maxillary palpi 4-segmented, fourth shortest, second usually longest. Integument of head, thorax and terga variously sculptured but mesoscutum usually with large posteromedian area impunctate and metasomal tergum 1 often with punctures restricted to basal third or less of dorsal surface medially; tegulae, metanotum and propodeum as in Eumelissodes. Tergum 6 with gradulus with lateral parts lamelliform and often ending abruptly in a short blunt tooth (in Eumelissodes lateral parts of gradulus of tergum 6 absent or cariniform and short); pygidial plate broadly V-shaped with rounded apex to narrowly U-shaped at least apically.*

Vestiture variable; without spatuloplumose hairs; tergum 2 with distal pubescent band interrupted medially, often broadly so; scopal hairs weakly to profusely plumose, brown in one species.

*Male.* Color and structure as in female with the following additions: clypeus pale, yellow to white, never partially or wholly black; base of mandible with yellow to white macula; labrum white, with or without narrow apical dark brown margin; terga with apical margins piceous to translucent brown, never colorless or transparent; *minimum length of first flagellar segment always shorter than half maximum length of second segment and rarely more than one-third of second segment; terga 6 and 7 with short lateral teeth; pygidial plate notched laterally near apex; sternum 4, and usually sterna 2, 3 and 5, with apical margin broadly convex, often produced into a more or less hyaline flap and often weakly emarginate medially (in Eumelissodes these sterna not broadly convex but straight or usually broadly concave apically).*

Genital capsule as in *Eumelissodes*. *Sternum 7 with median plate* relatively large, flat (curled laterally over neck of median plate in one species), with abundant short hairs ventrally, *with distinct neck region* (plate proper extends mesally and laterally beyond neck region), *with inner margin of neck smoothly curved, not forming an abrupt angle basally near margin of sternum proper* (as occurs in *Eumelissodes*). Sternum 8 as in *Eumelissodes* but often with apical hairs sparse or absent.

Vestiture as in female except as follows: tergum 2 with distal pale pubescent band usually not or only narrowly interrupted; tergum 5 with pubescent band similar to that of tergum 4; terga 6 and 7 with hairs white to dark brown.



## KEY TO THE SPECIES OF THE SUBGENUS CALLIMELISSODES

## MALES

1. Sternum 4 with a broad, hyaline, apical flap medially as long as basal part of sternum and feebly emarginate medially; sternum 3 with broad, bilobed, hyaline flap similar to sternum 2 but shorter; sterna 2 and 5 broadly convex and hyaline apically; clypeus white or cream-colored (rarely pale yellow) ..... *stearnsi*  
 Sternum 4 with apex broadly convex and emarginate medially but not forming a broad hyaline flap; sternum 3 with apical margin convex to almost straight; sterna 2 and 5 with margins weakly convex to straight; clypeus white, cream-colored or yellow ..... 2
- 2 (1). Genal area laterad of compound eye with round punctures as large as punctures elsewhere on head (except clypeus) and separated mostly by one puncture width or less; vertex between lateral ocelli and apex of compound eye with deep, round punctures separated mostly by less than one puncture width ..... 9  
 Genal area laterad of compound eye with minute punctures mostly separated by two or more puncture widths; vertex between lateral ocellus and compound eye with small punctures separated by one or more puncture widths ..... 3
- 3 (2). Flagellar segments 4 through 10 with narrow, shallow, shiny, longitudinal depressions on outer surface, segments 3 and 11 often also with such foveae partly developed ..... 5  
 Flagellar segments 5 through 10, at most, with narrow depressions on outer surfaces and usually only segments 5 through 9 ..... 4
- 4 (3). Minimum length of first flagellar segment equals more than one-fourth of maximum length of second segment; galeae opaque above, dulled by dense, regular tessellation; flagellar segments without narrow shallow depressions laterally, although there may be shiny flattened areas present, ..... *nigracauda*  
 Minimum length of first flagellar segment usually equals one-fourth or less of maximum length of second segment; galeae shiny to dull above, but *if* dulled, first flagellar segment equals less than one-fourth second segment; flagellum with at least some segments with narrow, longitudinal, shallow depressions laterally ..... 10
- 5 (3). Penultimate flagellar segment twice as long as broad or shorter ..... 6  
 Penultimate flagellar segment more than twice as long as broad ..... 7
- 6 (5). Galeae opaque, dulled above by dense, coarse, regular tessellation; minimum length of first flagellar segment equals less than one-fifth maximum length of second segment. . 11  
 Galeae moderately shiny to shiny above, slightly dulled by

- delicate reticular shagreening, not tessellate; minimum length of first flagellar segment equals more than one-fifth maximum length of second segment..... *clarkiae*
- 7 (5). Terga 2 and 3 with suberect to erect, simple hairs in apical areas; galeae usually shiny and unshagreened or with delicate reticular shagreening; flagellar segment 3 usually with well-developed ventrolateral depression present..... 12
- Terga 2 and 3 with apical areas bare, without simple suberect hairs; galeae often shagreened above; flagellar segment 3 often lacking ventrolateral depression or this depression weak and short..... 8
- 8 (7). Terga 2 and 3 with interband zones with abundant, deep, round punctures separated mostly by much less than one puncture width; eyes usually blue or greenish blue, *composita*
- Tergum 3, and often tergum 2, with interband zone punctures separated mostly by one puncture width and many by two or three puncture widths; eyes usually green or yellowish green ..... *lustra*
- 9 (2). Small bees; wing membranes slightly or not at all infumate; tergum 2 with pale pubescent band complete or interrupted medially by no more than one-third width of tergum; penultimate flagellar segment half as broad as long or slightly longer..... *tuckeri*

FEMALES

1. Galeae above with abundant, long, hooked hairs; terga 2 to 4 covered by short pale pubescence (unless worn); terga 5 and 6 with long hairs dark ochraceous or ochraceous medially to white laterally..... *stearnsi*
- Galeae above with relatively sparse, short, straight hairs; terga 2 to 4 not completely covered by diffuse pale pubescence; terga 5 and 6 with hairs usually dark brown at least medially ..... 2
- 2 (1). Scopal hairs weakly branched, with one to three branches on each side of rachis..... *clarkiae*
- Scopal hairs profusely branched, with more than three branches on each side of rachis..... 3
- 3 (2). Scopal hairs mostly dark brown (occasionally pale brown medially); abdominal vestiture dark brown or black (rarely with slight amount of pale pubescence on tergum 2); galeae densely tessellate..... *nigracauda*
- Scopal hairs white to yellow, brown only near basitibial plate and at apex of basitarsus; galeae variously sculptured... 4
- 4 (3). Ultimate flagellar segment as broad as long, truncate... *lupina*
- Ultimate flagellar segment distinctly longer than broad, rounded or obliquely truncate apically..... 5
- 5 (4). Large bees, 11 to 16 mm. in length; wing membranes deeply infumate, brown; tergum 2 with short lateral pale pubescent fasciae separated by more than one-third of tergum; pale vestiture yellow-ochre in color..... *coloradensis*

- Small to large bees, 8 to 15 mm. in length; wing membranes hyaline, slightly or not at all infumate; tergum 2 with distal pubescent band often interrupted medially but usually separated by one-third or less of width of tergum; pale vestiture white to ochraceous, rarely rufescent, in color . . . . . 6
- 6 (5). Integument coarsely punctate, punctures of genal area laterad of compound eye deep, round, separated by less than one puncture width; mesepisterna with crowded, round, almost confluent, deep punctures, surface dulled by fine shagreening . . . . . *tuckeri*
- Integument less coarsely punctate, genal area laterad of compound eye with minute punctures crowded into narrow zone near eye, elsewhere sparse and separated mostly by more than one puncture width . . . . . 7
- 7 (6). Head with hairs all or mostly black to dark brown; inner surface hind basitarsi and usually tibiae with dark reddish brown to black hairs; galeae above moderately shiny to shiny, unshagreened or with delicate shagreening . . . *metenua*
- Head hairs usually all pale except abundant dark hairs on vertex; inner surface hind basitarsi and tibiae with hairs usually pale, yellow to red; if head hairs mostly dark and inner surface hind basitarsi with hairs dark, then galeae opaque above, dulled by dense, coarse tessellation . . . . . 8
- 8 (7). Tergum 1 with crowded punctures restricted to basal third or less medially, middle third, if punctate, with punctures separated mostly by more than two puncture widths; galeae above moderately shiny, often with delicate reticular shagreening but not densely tessellate . . . . . 9
- Tergum 1 with crowded punctures at least in basal half medially and often more, middle third of tergum with punctures separated mostly by one puncture width or less at least basally; galeae above moderately shiny with delicate shagreening to densely and regularly tessellate . . . 11
- 9 (8). Inner surface hind basitarsus with dark reddish brown to black hairs; scopal hairs often yellow; terga 5 and 6 with dark brown to black hairs, with or without lateral tufts of white hairs . . . . . *glennwoodensis*
- Inner surface hind basitarsi with hairs yellow to red; scopal hairs white to pale ochraceous; terga 5 and 6 with pale brown to golden hairs medially and with large lateral tufts of white hairs . . . . . 10
- 10 (9). Mesoscutum with punctures just mesad of parapsidal line deep, separated mostly by half a puncture width or less, usually or mostly larger than scutellar or mesepisternal punctures . . . . . *composita*
- Mesoscutum with punctures just mesad of parapsidal line shallow, separated mostly by more than half a puncture width (many by two or more puncture widths), of irregular size but often or mostly smaller than most scutellar or mesepisternal punctures . . . . . *lustra*

- 11 (8). Galeae above moderately shiny, somewhat dulled by delicate reticular shagreening especially in apical half or less, *plumosa*  
 Galeae above opaque, dulled by dense, coarse, regular tessellation ..... 12
- 12(11). Inner surface hind basitarsi with hairs dark reddish brown to black; head hairs all or mostly dark brown or at least face below vertex with a few dark hairs mixed with the pale, *ablusa*  
 Inner surface hind basitarsi with hairs yellow to dark reddish brown; head hairs all white except brown hairs on vertex, face below vertex without dark hairs ..... 13
- 13(12). Inner surface hind basitarsi with hairs orange; mesoscutal pale hairs dark ochraceous, dark brown patch extends forward beyond transverse line at anterior margins of tegulae, *tribas*  
 Inner surface hind basitarsi with hairs dark red to dark brown; mesoscutal pale hairs white, dark patch not extending forward to a transverse line at anterior margins of tegulae ..... *minuscula*

*Melissodes (Callimelissodes) lupina* Cresson

*Melissodes lupina* Cresson, 1878, Acad. Nat. Sci. Philadelphia, vol. 30, p. 210; Fowler, 1902, Report of the work of the Agric. Exper. Sta. of the Univ. California, 1898-1901, pt. 2, p. 323; Cockerell, 1903, Psyche, vol. 10, p. 77; 1905, Bull. S. California Acad. Sci., vol. 22, p. 305; 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 31, 80; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309; 1909, Trans. Kansas Acad. Sci., vol. 22, p. 305; Cresson, 1916, Mem. Amer. Ent. Soc., vol. 1, p. 122; Cockerell, 1939, Proc. California Acad. Sci., ser. 4, vol. 23, p. 428; 1939, Bull. S. California Acad. Sci., vol. 38, p. 137; Linsley, 1946, J. Econ. Ent., vol. 39, p. 20; Bohart, Knowlton, Bailey, 1950, Utah State Agric. College Mimeo. series no. 371, p. 5.

*Melissodes intermediella catalinensis* Cockerell, 1905, Bull. S. California Acad. Sci., vol. 4, p. 102 (new synonymy).

*Melissodes humilior catalinensis*, Cockerell, 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 366.

*Melissodes catalinensis*, Cockerell, 1923, Proc. California Acad. Sci., ser. 4, vol. 12, p. 86; 1939, Proc. California Acad. Sci., ser. 4, vol. 23, p. 429.

*Melissodes catalinensis vanduzeei* Cockerell, 1923, Proc. California Acad. Sci., ser. 4, vol. 12, p. 86 (new synonymy).

The females of this species can be distinguished from females of all other species of the genus *Melissodes* by the short apical flagellar segments and by the form of the tibial scopal hairs as described below. The males can be distinguished from other males of the subgenus *Callimelissodes* by the galeae being dulled above, the relatively short first flagellar segment and the lack of a longitudinal sulcus on flagellar segments two through four. In addition, the males have the labrum and mandibular bases yellow and the apical areas of terga 2 to 4 provided with suberect simple hairs.

*Female.* Measurements and ratios: N, 20; length, 9-13 mm.;



width, 3-4 mm.; wing length,  $M = 3.23 \pm 0.229$  mm.; hooks in hamulus,  $M = 12.20 \pm 0.673$ ; flagellar segments 1/segment 2,  $M = 1.73 \pm 0.087$ .

Structure and color: Integument black; distitarsi and apical half of mandible rufescent; flagellar segments 3-10 (and often apex of segment 2) red to yellow beneath; eyes usually bluish-gray or gray; wing membranes colorless, veins dark brown; tibial spurs yellow to white.

Clypeus with large, shallow, rounded punctures separated mostly by half a puncture width or less, surface dulled by irregular shagreening, without a well-defined boss or median carina apically; supraclypeal area with scattered, deep punctures, surface usually dulled by coarse, reticular shagreening; flattened lateral areas of vertex extending medially and somewhat posterior from apices of compound eyes moderately shiny, dulled by small, round punctures separated by one puncture width or less and by delicate, sparse shagreening; apical flagellar segment as broad as long or broader, truncate; eyes in facial view slightly less than three times as long as wide, converging strongly towards mandibles; maxillary palpal segments in ratio of about 2.4:2.2:2.0:1.0, fourth segment often shorter; galeae with scattered punctures bearing short straight hairs, surface opaque, dulled by dense, regular tessellation. Mesoscutum with punctures round, deep, crowded anteriorly and laterally, but sparse in posteromedian area where separated mostly by two puncture widths and often much more, surface shiny posteromedially but usually dulled anteriorly and laterally by fine shagreening; scutellum with punctures slightly smaller than on adjacent area of mesoscutum and generally more crowded, surface usually dulled by extremely fine shagreening; metanotum with abundant round punctures distinctly smaller than those of mesoscutum, separated mostly by half a puncture width or less, surface opaque, dulled by delicate, fine tessellation; mesepisternum with lateral surface with shallow, round punctures separated mostly by one or less puncture widths, surface dulled by irregular reticular shagreening; propodeum with dorsal surface reticulorugose except medially, posteriorly rugae often assume aspect of discrete large punctures, posterior surface with distinct round punctures separated by one-half to one puncture width except impunctate upper median triangular area, lateral surfaces with crowded punctures, surfaces opaque, dulled by delicate, fine tessellation. Metasomal tergum 1 with basal three-fifths with small, round, shallow punc-

tures crowded basally and laterally, sparser apically except crowded zone at margin of punctate area, apical two-fifths impunctate, surface dulled by dense, reticular shagreening; tergum 2 with basal zone with small, round punctures separated mostly by one puncture width, interband zone with irregular shallow punctures which in lateral raised areas separated mostly by less than one puncture width and medially mostly by two puncture widths, apical zone with minute shallow punctures separated by one to three puncture widths, surface dulled by dense, reticular shagreening; terga 3 and 4 similar, but punctures more crowded in interband zones; pygidial plate V-shaped.

Hair: On head pale ochraceous to white except dark brown on vertex. Thoracic hairs ochraceous to pale ochraceous except as follows: mesoscutum with large dark brown posteromedian patch extending forward usually to a transverse line at anterior margins of tegulae; scutellum with large dark brown median area. Metasomal tergum 1 with long pale ochraceous hairs basally and laterally; tergum 2 with basal zone with long pale ochraceous pubescence, with interband zone with short, suberect, relatively simple, brown to dark ochraceous hairs, with broad, arched, distal, pale pubescent band usually interrupted medially and reaching or almost reaching apex of tergum laterally, with apical area with short, simple, appressed to suberect, brown to ochraceous hairs except narrow glabrous margin; tergum 3 similar to tergum 2 but interband zone often with sparse, appressed, pale pubescence and pale distal pubescent band broader, not interrupted medially and extending to apical margin laterally; tergum 4 with broad apical pale ochraceous pubescent band, occasionally with a few simple, pale hairs near margin medially; terga 5 and 6 with dark brown hairs except lateral pale ochraceous tufts; sternal hairs reddish brown medially to ochraceous laterally. Legs with pale ochraceous to white hairs except as follows: distitarsi usually, basitarsi and inner surfaces of fore tibiae brown, inner surfaces of middle and hind basitarsi dark red to dark brown (usually paler on middle basitarsus), on basitibial plates brown; scopal hairs white to ochraceous, with rachises not extending much beyond plumose part, each hair usually with 4 to 6 branches on each side in apical half or less, with two to several scopal hairs on posterior part of apex of tibia almost sinuous, bent to shape of surface of apical, hairless area of tibia.

*Male.* Measurements and ratios: N, 20; length, 7.5-11.0 mm.; width, 2.5-4.0 mm.; wing length,  $M = 3.12 \pm 0.206$  mm.; hooks in

hamulus,  $M = 10.95 \pm 0.526$ ; flagellar segment 2/segment 1,  $M = 7.14 \pm 0.189$ .

Structure and color: Integument black except as follows: clypeus, base of mandible and labrum yellow (labrum without dark margin); flagellum yellow to red below (except first segment), dark brown above; eyes gray to bluish gray, rarely greenish blue; wing membranes hyaline, veins brown to black, metasomal terga 2-5 usually opaque, brown, occasionally translucent and yellowish apically; distitarsi rufescent; tibial spurs yellow to white.

Eyes strongly converging towards mandibles, about three-eighths as wide as long; minimum length of first flagellar segment less than one-fifth maximum length of second segment; flagellar segments 5 to 9 with elongate, shiny, shallow, dorsolateral depressions (occasionally also on segment 10 but never on segment 11), penultimate segment more than twice as long as wide, last segment more than three times as long as broad. Maxillary palpal segments in ratio of about 3.25:3.75:2.75:1.0. Apical margin of sternum 4 with broad flap shallowly emarginate medially; sterna 3 and 5 distinctly convex apically. Sculpturing as in female with the following differences: clypeus with punctures coarse and irregular, with surfaces moderately shiny, slightly dulled by sparse coarse shagreening; supraclypeal area with surface usually dulled by dense tessellation; galeae above with coarse shagreening; tergum 1 with basal four-fifths punctate; terga 2-4 with apical areas often with minute punctures (at least a few present near distal pubescent bands).

Sternum 7 with median plate slightly turned laterad, with long, slender neck, with apicolateral angle narrow (almost strap-shaped). Sternum 8 with apicoventral tubercle bidentate apically, with few or no hairs at apex. Gonostylus two-thirds as long as gonocoxite, distinctly capitate, with a few slender hairs on outer and lower surfaces near base; spatha sinuate apically, about three times as wide as long; penis valve with dorsolateral lamella ending at spatha without being turned inward to form a tooth just in front of spatha (Figs. 38-41).

Hair: On head and thorax pale ochraceous to ochraceous, often with brown on vertex of head and usually with a few long brown hairs posteromedially on mesoscutum and almost always on scutellum. Metasomal tergum 1 with basal four-fifths with long pale ochraceous hairs, apically with short, suberect, simple, usually ochraceous, but often pale brown hairs almost to apex; tergum 2 with hairs white to pale ochraceous, basal pubescent band white,



distal pubescent band white and often narrowly interrupted medially, apical area with suberect, simple hairs usually pale ochraceous, but often brown; terga 3 and 4 as in tergum 2 but basal tomentum brown, distal pubescent band not interrupted and apical simple hairs often brown at least medially; tergum 5 as in tergum 4 but distal pubescent band usually reaching margin across entire tergum; terga 6 and 7 ochraceous to pale brown; sternal hairs pale ochraceous, often darkened medially; legs with white to pale ochraceous hairs except as follows: pale rufescent to yellow on inner surfaces of basitarsi and often distitarsi.

*Bionomics.* This bee is apparently oligolectic upon plants of the family Compositae. Table I summarizes the data leading to this conclusion. Of the 290 collections (787 bees) with flower data attached to the specimens 225 (659 bees) were collections from composites. The remaining 65 collections (128 bees) were collected from plants of 16 families other than composites and, although the numbers of bees are small in the case of each family, the numbers of males usually equal or exceed those of females. This indicates that these families of plants, such as Leguminosae and Polygonaceae, are important to the bees only as nectar sources. Furthermore, Linsley (1946, p. 26) in his study of the pollinators

TABLE II. Summary of Floral Records for *Melissodes lupina*.

Plant Data			Records of <i>M. lupina</i>			
FAMILY	Number of genera	Approximate number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae	28	48	225	436	223	659
Leguminosae	3	4	18	19	22	41
Polygonaceae	2	4	11	17	14	31
Hydrophyllaceae	3	4	8	5	6	11
Brassicaceae	3	3	6	2	6	8
Labiatae	3	3	6	10	4	14
Others (11)	13	13	16	10	13	23
Totals	55	79	290	499	288	787



of alfalfa in California states that *M. lupina* (as well as *M. agilis*) ". . . was rarely encountered or represented by a few males in search of nectar."

Nothing is known concerning the nesting habits of this species. It ranges from high elevations almost to sea level in the western states and is especially abundant in California where it is one of the most abundant species of the genus *Melissodes*.

*Type Material.* Lectotype male and three male paratypes of *lupina* from California are in the Academy of Natural Sciences of Philadelphia. Holotype female of *catalinensis* from Santa Catalina Island, Davidson collector, is in the University of Colorado Museum at Boulder. Holotype female of *vanduzeei* from Angeles Bay, Gulf of California, June 26, 1921, E. P. Van Duzee collector is in the collection of the California Academy of Sciences, San Francisco (Type No. 946).

*Distribution.* From Alberta, Canada, in the northeast to Colorado in the southeast, west to southern California and northwest to the state of Washington (Fig. 3). This species has been collected from May 4 until November 8, but mainly from the middle of June until the middle of September. In addition to the type material, 1080 females and 1337 males have been examined from the localities listed below. This list includes localities reported in the literature.

CALIFORNIA: Adobe Creek, Stanislaus Co.; Alameda foothills; Altadena; Antioch; Arroyo Mucho (20 miles S. of Livermore); Artois; Auburn; Avon, Bagby (5.3 miles N. E. of); Bakersfield (15 miles E. of); Bass Lake; Ben Grant Pass; Benica; Berkeley; Berkeley Hills, Alameda Co.; Big Oak Flat, Tuolumne Co.; Big Pine Canyon; Big Rock Creek; Blairsden; Boca Dam (11 miles E. of Truckee); Bolinas; Boquet Canyon (Angeles National Forest); Boulder Creek (4 miles N. W. of); Bridge Creek Camp, Lassen Co.; Bucks Lake, Plumas Co.; Burney (10 miles E. of); Byron; Caliente Mt., San Luis Obispo Co.; Calpine; Calistoga; Cambria Pines, San Luis Obispo Co.; Camp Baldy, Los Angeles Co.; Canby; Capitola; Carbon; Carmel; Carrville; Carson Pass, Alpine Co.; Castle Crags, Shasta Co.; Catalina Island (Fisherman's Cove); Cazadero; Chico; Chile Bar; Clayton; Clovis (4 miles N.); Coalinga; Coffee Canyon, Trinity Co.; Contra Costa Co.; Corral Hollow, San Joaquin Co.; Costa Mesa; Crystal; Cummings; Dales; Davis; Davis Creek, Modoc Co.; Deer Creek, Tehama Co.; Democrat Springs, Kern Co.; Devore; Dixon; Downieville; Dutch Flat, Placer Co.; Eagle Rock; Eagle

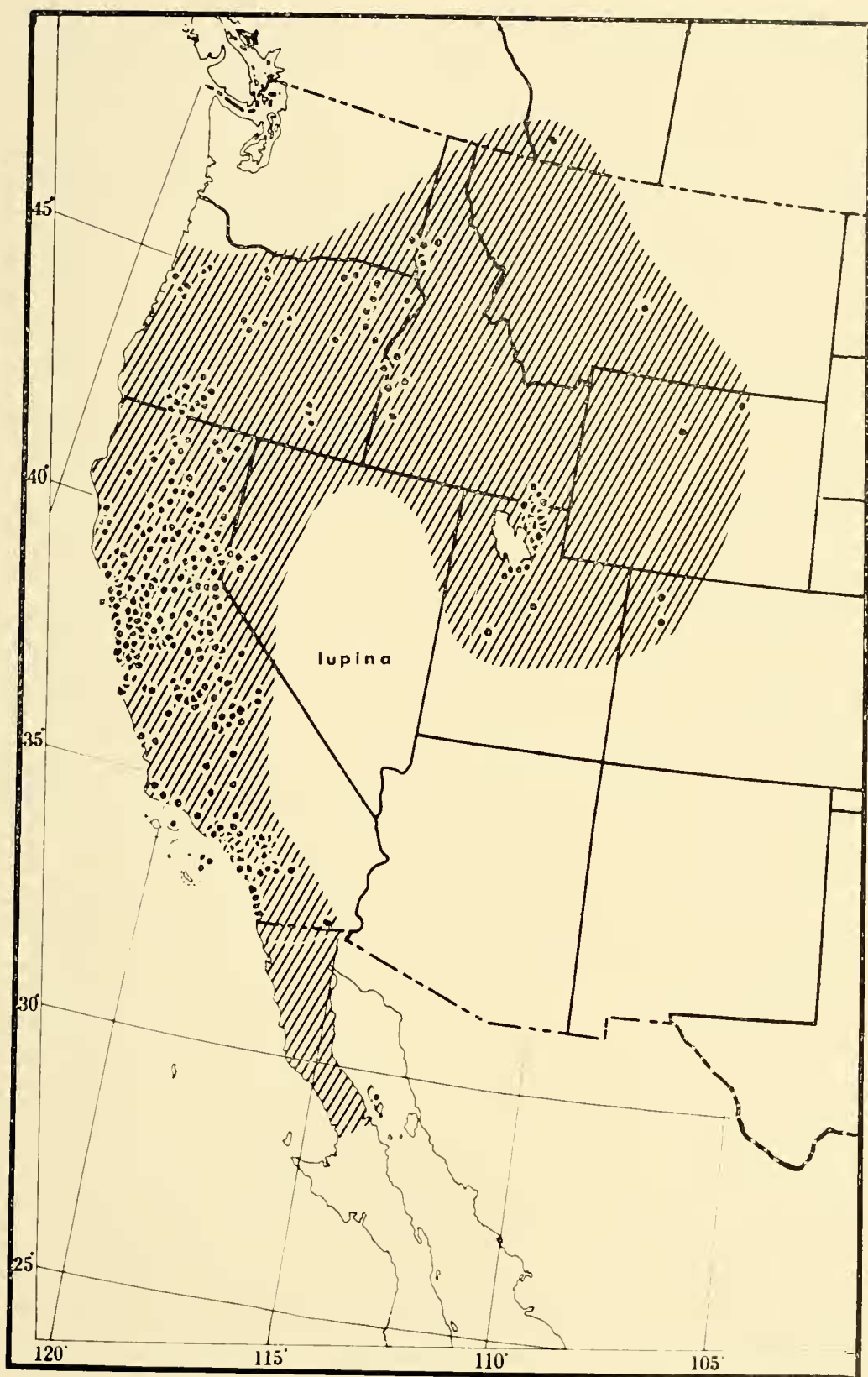


FIG. 3. Map showing the known distribution of *M. (Callimelissodes) lupina* Cresson.

Rock Hills, Los Angeles Co.; Encinitas; Fairfax; Felton; Felton Station, Santa Cruz Co.; Firebaugh; Folsom; Fresno; Friant; Fruto; Galivan; Giant Forest; Glen Blair (mud flats); Glenn Canyon (Santa Cruz Mts.); Guerneville; Harris Spring, Siskiyou Co.; Hemet; Hillsboro; Hobart Mills; Hope Valley, Alpine Co.; Hospital Canyon, Riverside Co.; Huntington Lake; Idyllwild (San Jacinto Mts.); Inverness; Jacksonville; Jamesburg (Hasting's Natural History Reservation); Galivan, Orange Co.; Keddie; Kernville; Knoxville; Kyburz; Laguna Beach; Lagunitas; La Jolla; Lake Almanor, Plumas Co.; Lake Tahoe; Lassen Peak, Shasta Co.; Lebec; Lemon Cove; Linden (10 miles E.); Lindsey; Litchfield; Livermore (13 miles S. of); Loomis; Lower Panoche Creek, Fresno Co.; Lytle Creek, San Bernardino Co.; Madera; Mammoth; Marin Co.; Mariposa, Mariposa Co.; Marsh Creek, Contra Costa Co.; Martinez; Marysville; Mascama Creek, Sonoma Co.; Mason Creek Railroad Siding, Modoc Co.; Maxwell; McCloud; Meadow Valley, Plumas Co.; Mendocina Co.; Mendota; Merced Falls, Merced Co.; Middletown; Midway Wells; Milbrae; Mill Creek, San Bernardino Co.; Mineral King; Mint Canyon; Mission Valley; Mix Canyon, Solano Co.; Modesto; Mokelumne Hill, Calaveras Co.; Monterey; Monte Rio; Mountain View; Mount Diablo, Contra Costa Co.; Mount George, Napa Co.; Mount Harmon, Santa Cruz Co.; Mount Santiago; Mt. Shasta; Murphys, Meyers, Napa Co.; Nelson; Nevada City; Newport Beach; Oak Glen Lodge, San Bernardino Co.; Oakland (hills back of); Oakley; Oceanside; Onion Valley, Plumas Co.; Orinda; Orinda Cross Road, Contra Costa Co.; Oroville; Pacific Grove; Palmdale (Mohave Desert); Palo Alto; Paraiso Springs, Putah Canyon, Yolo Co.; Pasadena; Patterson; Pebbly Beach, Catalina Island; Pinecrest; Pine Knot (Bear Lake); Pinnacles, San Benito Co.; Placerville; Point Reyes, Marin Co.; Pollock Pines, Eldorado Co.; Portola; Puente Hills; Quincy; Raisin City; Red Bluff; Redding; Redwood City; Reseda; Richardson's Spring, Butte Co.; Rio Vista; Riverside; Romoland; Ryan Creek, Mendocina Co.; Sacramento; Sage Hen (near Hobart Mills); Salinas; Samapara; San Antonio Railroad Siding (7 miles S. of), Santa Clara Co.; San Antonio Valley, Santa Clara Co.; San Benito; San Diego; San Fernando; San Francisco; San Mateo; San Mateo Co.; San Ramon; Sonoma Co.; Santa Barbara; Santa Cruz; Santa Cruz Island; Santa Maria (8 miles N.E. of); Santa Monica; Santa Paula; Sargent; Sebastopol; Sequoia National Park (Ash Mt.); Serra; Seven Oaks (San Bernardino Mts.); Shasta Co.; Shaver Lake, Fresno Co.;



Sherman Island; Shingletown; Sierraville; Snowline Camp, Eldorado Co.; Soda Bay (Clear Lake); Squaw Valley, Fresno Co.; Stanford University; Stevens Creek, Santa Clara Co.; Stockton; Strathmore; Strawberry; Strawberry Canyon, Tuolumne Co.; Sutter Buttes, Butte Co.; Tahquitz Valley (San Jacinto Mts.); Tamales Bay (near Marshalls); Tanbark Flat (San Gabriel Mts.); Los Angeles Co.; Termo (3 miles N.); Tesla; Tetley Park (San Bernardino Mts.); Three-Rivers; Tilden Park (San Francisco); Tolay Creek, Sonoma Co.; Tracy; Trimmer; Trinity Co.; Truckee (2 miles N.); Tucker's Grove, Santa Barbara Co.; Tuolumne Co.; Turlock; Twain Harte, Tuolumne Co.; Vallejo; Valley of the Falls; Vincent; Vineburg; Viola; Walnut Creek; Washington; Watts Valley, Fresno Co.; Weber Lake; Weed; West Hollywood Hills; Westley; Westwood Hills, Los Angeles Co.; Whittier; Williams; Willits; Willows; Winters; Wood Lake; Woodland; Yorba Linda; Yosemite; Yosemite Valley. COLORADO: Maybell, Meeker. IDAHO: Cornell; Coyote Grade, Nez Perce Co.; Cub River Canyon; Downey; Emmett (10 miles E. on Squaw Creek), Gem Co.; Franklin; Grand View; Lewiston; Midvale; Moscow; Parma; Preston. MONTANA: Winnecook, Wheatland Co. NEVADA: Gold Hill, Storey Co.; Reno (Sky Ranch); Verdi; Wadsworth. OREGON: Alsea Mt., Benton Co.; Antelope Mt., Harney Co.; Ashland (12-15 miles E. on Dead Indian Road); Baker; Cayuse; Coleson; Corvallis; Cove; Crater Lake Park; Durkee; Eagle Ridge (Klamath Lake); Elgin (3 miles S. of); Frenchglen; Hereford; Klamath Falls; Kirk (Klamath Marsh); Lake of Woods, Klamath Co.; Maupin; Medford; Mitchell (14 miles E. of); North Powder; Ontario; Pelican Bay, Klamath Co.; Pendleton (9 miles E. of); Prairie City; Prineville; Prospect; Salem; Siskiyou Summit, Jackson Co.; Steen Lake (near Alterson); Steens Mts. (head of Blitzen River); Summitt Prairie; Thomas; Three-Sisters (Dog Camp and Scott Lake); Tigh Valley; Tumalo Reservation, Deschutes Co.; Wallowa National Forest (Lick Creek Railroad Siding); Wood's Creek, Benton Co. UTAH: Ballard; Bear River City; College; Collinston; Delta; Erda; Grantsville; Huntsville; Hyrum; Kaysville; Lakespoint; Lewiston; Lincoln; Logan; Mendon; Petersboro; Pineview; Plain City; Portage; Salt Lake City; Smithfield; Thistle; Trenton. WASHINGTON: Pullman. WYOMING: Leider; Worland. ALBERTA: Lethbridge.

*Flower Records.* *Adenostegia pilosa*, *Adenostoma* sp.; *Arctium* sp., *Aster* sp., *A. chilensis*, *A. exilis*, *Calchortus nuttalli*, *Centaurea solstitialis*, *Centromadia* sp., *C. pungens*, *Chaenactis artemisiae*-



*folia*, *C. glabriuscula*, *Chrysopsis villosa*, *Chrysothamnus* sp., *C. nauseosus speciosus*, *C. v. viscidiflorus*, *Cirsium* sp., *Cleome serrulata*, *Coreopsis* sp., *C. lanceolatum*, *C. tinctoris*, *Corethrogyne* sp., *C. bernardense*, *C. flaginifolia*, *Cosmos* sp., *Croton* sp., *C. californicus*, *Cryptantha intermedia*, *Eremocarous setigerus*, *Ericameria palmeri*, *Erigeron* sp., *E. foliosus*, *Eriodictyon* sp., *E. angustifolium*, *Eriogonum* sp., *E. fasciculatum*, *E. gracile*, *E. latifolium*, *Eriophyllum confertiflorum*, *Godetia bottae*, *Grindelia* sp., *G. camporum*, *G. elata*, *G. squarrosa*, *Gutierrezia californica*, *G. sarothrae*, *Haplopappus* sp., *H. bloomeri angustatus*, *Helenium bigelovi*, *Helianthus* sp., *H. annuus*, *H. gracilentus*, *Hemizonia* sp., *H. fasciculata*, *H. heermannii*, *H. lobbii*, *H. luzulaefolia*, *H. paniculata*, *H. wrightii*, *Heterotheca grandiflora*, *Holodiscus discolor*, *Iris hartwegi*, *Ligustrum* sp., *Lotus* sp., *Lythrum* sp., *L. californicum*, *Mallacothrix* sp., *Marrubium vulgare*, *Medicago sativa*, *Melilotus* sp., *M. alba*, *M. indica*, *Nemophila* sp., *Perezia microcephala*, *Phacelia* sp., *P. heterophylla*, *P. humulis*, *Phalacroseris bolanderi*, *Pimpinella* sp., *Polygonum auberti*, *Raphanus* sp., *Rhamnus californica*, *Salvia* sp., *S. carduacea*, *Senecio* sp., *Solidago* sp., *S. californica*, *S. elongata*, *S. occidentalis*, *Stephanomeria exigua*, *S. virgata*, *Trichostema* sp., *T. laxum*, *Trifolium repens*.

*Melissodes (Callimelissodes) plumosa*, n. sp.

This species closely resembles *lupina*, but it probably is more closely related to *metenua*. Both sexes of *plumosa* can be separated from those of *lupina* by the form of the flagella, as described under *lupina*. The females of *plumosa* can be distinguished from those of *metenua* by the paler color of the vestiture, as described below. The males of this species can be distinguished from those of *metenua* only with difficulty. The males of *plumosa* usually have the galeae dulled by delicate tessellation above, and usually have paler and more finely sculptured clypei than those of *metenua*.

*Female*. Measurements and ratios: N, 19; length, 10-12 mm.; width, 3.5-4.0 mm.; wing length,  $M = 3.40 \pm 0.098$  mm.; hooks in hamulus,  $M = 12.32 \pm 0.154$ ; flagellar segment 1/segment 2,  $M = 2.12 \pm 0.034$ .

*Structure and color*: Color of integument as in *M. lupina*. Sculpturing and structure as in *lupina* with the following differences: clypeus with punctures averaging slightly smaller, more regularly round in shape, usually with weakly developed median longitudinal carina in apical half, surface moderately shiny, with reticular sha-

greening; supraclypeal area with sparse large punctures, surface shiny, unshagreened or only slightly so; apical flagellar segment longer than broad; maxillary palpal segments in ratio of about 4.6:3.6:3.6:1.0; galeae with surface dulled by reticular shagreening but moderately shiny. Mesoscutum with posteromedian area often impunctate, surface shiny, not shagreened laterally and anteriorly; surface of scutellum unshagreened; mesepisternum with lateral surface with punctures separated by half or less of one puncture width, surface shiny, with sparse, fine shagreening. Metasomal tergum 1 with basal crowded punctures separated mostly by one puncture width or slightly more; tergum 2 with basal zone with punctures separated mostly by slightly more than one puncture width, apical area with punctures extremely sparse and minute; pygidial plate U-shaped, apical half with sides subparallel, except rounded tip, and diverging only in basal half or less.

Hair: Color of vestiture as in *M. lupina* with the following differences: tergum 4 without simple hairs apicomediaally; terga 5 and 6 with brown hairs often much paler than in *lupina*, those of tergum 6 often orange or golden-brown; sternal hairs golden medially to white laterally; legs with hairs of inner surfaces of middle and hind basitarsi and tibiae golden yellow to orange, on basitibial plates pale brown; scopal hairs with rachises not extending much beyond plumose part, usually with 6 or more branches on each side of rachis; apicoposterior tibial scopal hairs usually not sinuate, but occasionally so.

*Male.* Measurements and ratios: N, 20; length, 9-12 mm.; width, 2.5-4.0 mm.; wing length,  $M = 3.17 \pm 0.203$  mm.; hooks in hamulus,  $M = 11.15 \pm 0.182$ ; flagellar segment 2/segment 1,  $M = 4.28 \pm 0.099$ .

Structure and color: Integumental color as in *M. lupina* except yellow clypeus and base of mandible usually pale yellow and wing veins reddish-brown to brown.

Sculpturing and structure as in *lupina* with the following differences: minimum length of first flagellar segment equals one-fifth or more of maximum length of second segment; penultimate flagellar segments 3 to 10 with shiny, elongate, dorsolateral depressions, and often at base of segment 11 as well; maxillary palpal segments in ratio of about 4.5:3.0:3.0:1.0. Clypeus with crowded, round punctures, in posteromedian area separated by less than one puncture width, surface dulled by reticular shagreening, especially in posterior half; supraclypeal area usually shiny and unshagreened,

or only slightly dulled by shagreening; galeae usually dulled above by fine, reticular shagreening. Metasomal tergum 2 with depressed basal area with small round punctures separated mostly by two puncture widths; tergum 3 with interband zone with punctures separated by less than one puncture width; sternum 4 with apical flap usually not emarginate or only extremely shallowly; sterna 2, 3 and 4 with median impunctate areas usually dulled by dense reticular shagreening.

Sternum 7 with median plate flat, not twisted to face laterally, with apicolateral angle rounded, with short, broad neck, with abundant short hairs ventrally. Sternum 8 usually with one or two hairs apicomediaally. Gonostylus less than two-thirds length of gonocoxite, capitate, with sparse short hairs ventrally near base, none laterally; spatha as in *lupina*; penis valve with dorsolateral lamella turned inwards to form a tooth directed medially near spatha (Figs. 42-45).

Hair: Color of vestiture as in *M. lupina* with the following differences: metasomal tergum 2 with distal pale pubescent band often not interrupted medially; terga 3 and 4 with distal pale pubescent bands usually broader than in *lupina*.

*Type Material.* The holotype female, allotype male, one female and four male paratypes were collected by C. L. Fox at Davis Creek, Modoc County, California, July 13, 1922. Eight additional paratypes were collected by C. L. Fox at Davis Creek, Modoc County, California, as follows: July 14, 1922, 1 female; July 15, 1922, 5 females; July 16, 1922, 2 females. Five additional paratypes were collected by C. L. Fox at Buck Creek, Modoc County, California, as follows: July 21, 1922, 1 female and 3 males; July 25, 1922, 1 female. The holotype and allotype are in the collection of the California Academy of Sciences, San Francisco. Paratypes are in the collections of the California Academy of Sciences, Snow Entomological Museum at the University of Kansas, Lawrence, the U. S. National Museum, and in the author's collection.

*Distribution.* California, Oregon, Washington and North Dakota (Fig. 4). It is possible that the single male collected in North Dakota is misidentified and should be regarded as *M. metenua* (see the discussion of this below under *metenua*). In addition to the type material listed above, 6 females and 24 males have been examined. The collection data for these are given in full, since relatively few records are involved.



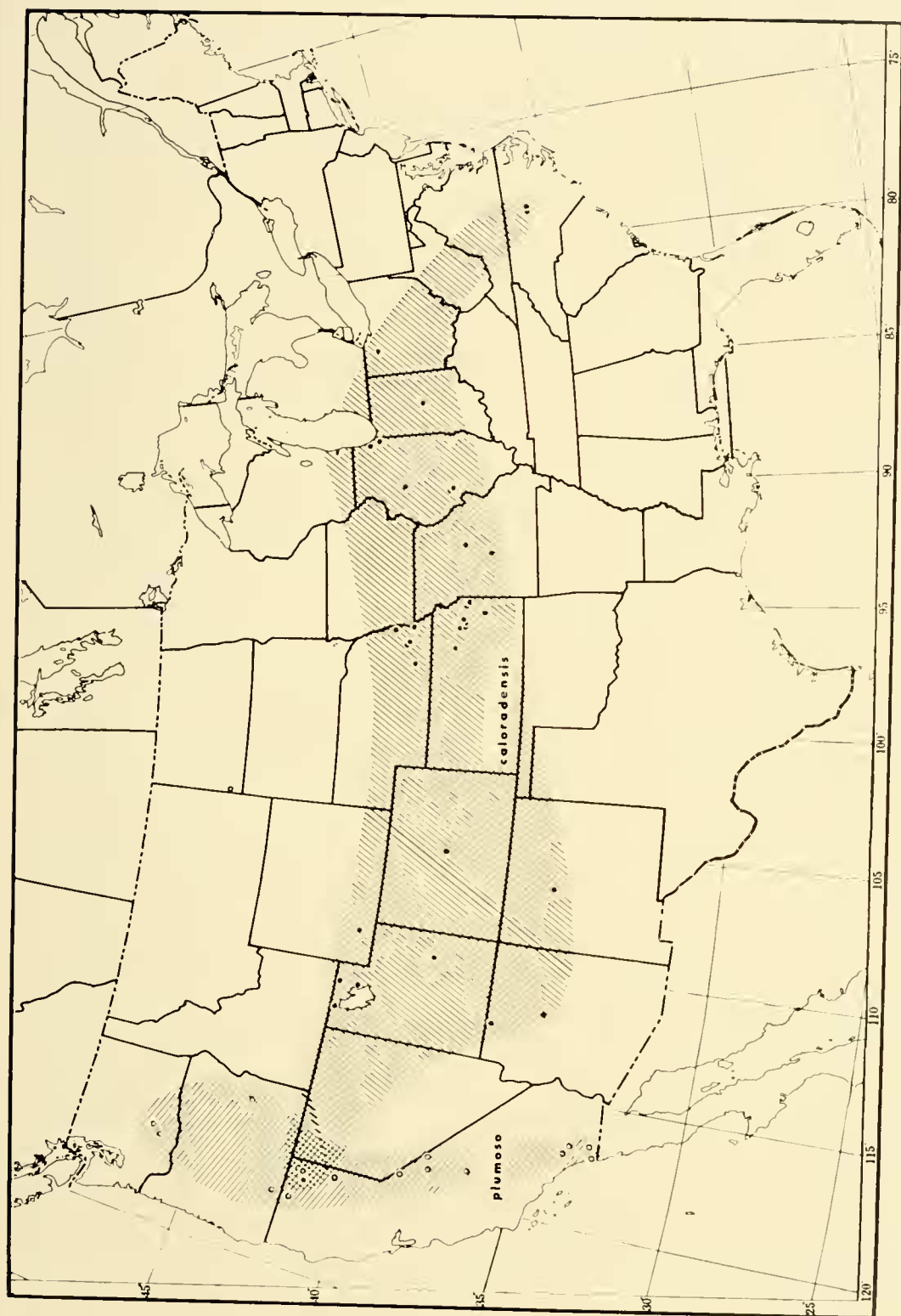


FIG. 4. Map showing the known distributions of *M. (Callimelissodes) plumosa* LaBerge and *M. (C) coloradensis* Cresson.



CALIFORNIA: Anza (2 miles E. of), Riverside Co., 1 female and 1 male on *Encelia californica*, July 7, 1956, E. G. Linsley; Bentons Crossing, Mono Co., 1 male, July 7, 1935, F. R. Platt; Goose Lake, Siskiyou Co., 1 male; Litchfield (22 miles N. of), Lassen Co., 1 male, July 10, 1946, P. D. Hurd and R. F. Smith; Mammoth, Mono Co., 1 male, July 6, 1933, and 1 male, July 8, 1933, G. E. and R. M. Bohart; Pine Valley, 2 females, June 16, 1934, M. T. James; Piñon Flat (4 miles W. of), San Jacinto Mts., 1 female, June 11, 1954, J. C. Hall; San Diego, 1 male, June 24, 1913, W. S. Wright; Sequoia National Park (Ash Mt.), 1 male, June 23, 1951, R. C. Bechtel, 6 males, June 9, 1952, R. C. Bechtel, 1 male, June 9, 1952, R. M. Bohart; Topaz Lake, Mono Co., 1 male, July 17, 1951, A. T. McClay, 2 males, June 26, 1957, J. W. MacSwain. NORTH DAKOTA: Marmarth, 1 male on *Helianthus petiolaris*, July 3, 1949, O. A. Stevens. OREGON: Juntura (Drinkwater Pass), 1 female, July 14, 1940, H. A. Scullen; Klamath Falls, 1 female, July 7, 1934, E. C. VanDyke. WASHINGTON: White Swan (8 miles S. of, on Mt. Adams Highway), Yakima Co., 1 male, August 24, 1941, B. Brookman; Yakima City, 2 males, July 2, 3 and 4, 1882.

*Melissodes (Callimelissodes) metenua* Cockerell

*Melissodes metenua* Cockerell, 1924, Pan-Pacific Ent., vol. 1, p. 56.

This is a small dark species closely related to *plumosa* and to *lupina*. The females of *metenua* can be separated from those of *lupina* by their longer ultimate flagellar segment and by the hairs of the head being all or almost all black. The females are distinguished from those of *plumosa* by the darker vestiture, as described below, and by the usually shiny galeae. The males of *metenua* are readily distinguished from those of *lupina* by the form of the flagellar segments, as described below, and by the shiny, usually unshagreened galeae. The males of *metenua* are exceedingly similar to those of *plumosa*. However, in *metenua* the galeae are usually unshagreened and shiny and the clypeus is brighter in color and more coarsely punctate than in *plumosa*.

*Female.* Measurements and ratios: N, 20; length, 9.0-11.5 mm.; width, 3-4 mm.; wing length,  $M = 3.32 \pm 0.149$  mm.; hooks in hamulus,  $M = 11.95 \pm 0.114$ ; flagellar segment 1/segment 2,  $M = 1.89 \pm 0.003$ .

Structure and color: Integumental color as in *M. lupina* with the following exceptions: eyes grayish green to bluish green; wing membranes slightly infumate, veins dark brown to black; tibial spurs rufescent to yellowish brown.

Sculpturing and structure as in *lupina* with the following differences: clypeal punctures round, separated mostly by less than half a puncture width, surface moderately shiny, somewhat dulled by transverse shagreening, especially posteriorly; supraclypeal area with the surface shiny, unshagreened or sparsely so; vertex with lateral flattened areas at apices of compound eyes shiny, punctures separated mostly by one or more puncture widths; apical flagellar segment distinctly longer than broad, rounded distally, eyes often slightly more than three times as long as broad; maxillary palpal segments in ratio of about 2.3:2.3:2.0:1.0, occasionally with a minute fifth segment; galeae with surface usually shiny and unshagreened or with extremely delicate, reticular shagreening. Mesoscutum with posteromedian area often impunctate, surface not usually dulled by shagreening anteriorly or laterally; scutellum with surface not shagreened; metanotum usually shiny medially; mesepisternum with punctures separated mostly by half a puncture width or less, surface shiny, delicately or not shagreened. Metasomal tergum 1 with basal half punctate, medially separated mostly by more than one puncture width and many by two or more puncture widths; tergum 2 with basal depressed area with round punctures separated by one to two puncture widths, with interband zone punctures small, separated mostly by two puncture widths or more in lateral raised areas, apical area essentially impunctate or with few shallow punctures near pale pubescent band; tergum 3 similar but punctures of basal and interband zones more crowded; pygidial plate narrowly V-shaped with rounded apex.

Hair: Vestiture variable; darkest individuals with hairs all black except scopal hairs pale yellow to whitish on tibia and pale yellow to brown on basitarsus, and outer surface of fore and middle tibiae white apically. The palest specimens are as follows: head hairs all black; thoracic hairs black to dark brown except mesoscutum pale ochraceous on anterior third and at extreme sides, scutellum fringed with pale, metanotum and propodeum above with pale, and mesepisternum with upper third of lateral surface with ochraceous hairs; metasomal tergum 1 with a few pale hairs mixed with the dark in basal half; tergum 2 with narrow lateral oblique fasciae of cinereous pubescence, fasciae separated by at least length of one fascia; tergum 3 with distal pale band of cinereous pubescence not reaching apex of tergum; tergum 4 with apical band of pale pubescence separated from apex in 5 and 6 with hairs all dark; scopal hairs pale yellow to white except brown near basitibial plate and

apically and laterally on basitarsus; fore and middle tibiae often white on outer surface near apex. In individuals between these two extremes pale hairs appear in the following order: first, in the pale fasciae of tergum 3 and on dorsal surface of propodeum and metanotum; second, laterally on tergum 4 and fringing scutellum and anteriorly on mesoscutum; third, on tergum 2, on mesepisterna and on base of tergum 1.

*Male.* Measurements and ratios: N, 20; length, 8-11 mm.; width, 2.5-3.5 mm.; wing length,  $M = 3.01 \pm 0.182$  mm.; hooks in hamulus,  $M = 11.15 \pm 0.150$ ; flagellar segment 2/segment 1,  $M = 4.39 \pm 0.087$ .

Structure and color: Integumental color as in *M. lupina* with the following exceptions: clypeus usually bright orange-yellow; eyes grayish green to bluish green; wing membranes slightly infumate; tibial spurs yellow to slightly brownish at edges.

Structure as in *M. lupina* with the following differences: eyes more than three-eighths as broad as long; minimum length of first flagellar segment one-fifth or less as long as maximum length of second segment; flagellar segments 3 to 10 and often base of 11 with shiny, longitudinal, dorsolateral depressions, penultimate segment distinctly longer than broad; maxillary palpal segments in ratio of about 3.0:2.8:2.0:1.0, often with minute fifth segment. Apical margin of sternum 4 with flap not emarginate medially or extremely shallowly so. Sculpturing as in *lupina* with the following exceptions: clypeal punctures coarse, especially posteromedially where separated often by one puncture width or more, surface shiny, unshagreened or only slightly so (especially posteriorly); supra-clypeal area with unshagreened or only delicately shagreened surface; galeae above shiny, unshagreened or with delicate reticular shagreening; terga 2-4 with apical areas impunctate or with few, scattered, shallow punctures basally near pubescent bands; sterna 2-4 with median impunctate areas shiny to moderately shiny, with delicate reticular shagreening.

Sternum 7 as in *M. plumosa* but hairs on ventral surface shorter and slightly sparser. Sternum 8 and genital capsule essentially as in *M. plumosa* (Figs. 46-49).

Hair: Color of vestiture as in *M. lupina* with the following differences: pale hairs of head and thorax usually dark ochraceous; often vertex of head, mesoscutum and scutellum with brown apices of metasomal terga with suberect, relatively simple hairs usually sparse and usually dark brown.



*Type Material.* Female holotype collected by E. P. Van Duzee at Colestin, Jackson Co., Oregon, July 30, 1918 (Type No. 1705), is in the collection of the California Academy of Sciences in San Francisco.

*Remarks.* One male identified as *M. plumosa* from Marmarth, North Dakota, could possibly be a *M. metenua* male. As stated above, the males of *metenua* and *plumosa* are very difficult to distinguish. The male from North Dakota has its galeae dulled by shagreening, thus it is here considered to be a *plumosa* male. However, it is out of the range of *plumosa* as understood from the other specimens, but was collected not far from the range of *metenua*. Also the clypeal punctation seems to be of the *metenua* type more than of the *plumosa* type.

*Distribution.* California north to Washington, east to Idaho and northwestern Wyoming, and south to northern Utah (Fig. 5). This species has been collected from June 8 until September 15, but mostly during July and August. In addition to the type material, 87 females and 86 males (of which 75 females and 76 males are from Oregon) have been examined from the localities listed below.

CALIFORNIA: Coalinga Pass; Copco, Siskiyou Co.; Eureka; Honeydew, Humboldt Co.; Lake City, Modoc Co.; Lassen Peak, Shasta Co.; Scotia. IDAHO: MOSCOW. OREGON: Antelope Mt., Harney Co.; Ashland (20 miles E. of); Baker; Bellfountain; Colestin; Corvallis; Dillard; Eugene; Foster; Grande Ronde River (N. of Imbler), Union Co.; Green Spring Mt. (17 miles W. of Ashland); Hereford; Independence; Lewisburg (5 miles E. of); Medford; Oakridge; Prineville (25 miles E. of); Roseburg; Shedd; Siskiyou Pass, Jackson Co.; Siskiyou Summit, Jackson Co.; Sixes River, Curry Co.; Sulphur Springs, Benton Co.; Summerville; Thomas; Umqua River, Douglas Co.; Unity. UTAH: Huntsville; Logan Canyon. WASHINGTON: Yakima. WYOMING: Yellowstone National Park.

*Flower records.* *Cosmos* sp., *Erigeron* sp., *Melilotus alba*. Only one of the females examined had collection data regarding the flowers it was visiting. This female was visiting *Melilotus alba*. Therefore, no statement regarding flower habits can be made at this time.

*Melissodes (Callimelissodes) clarkiae*, n. sp.

This distinctive bee is clearly related to the foregoing three species (*lupina*, *plumosa* and *metenua*), but probably most closely to *plumosa*. The females are as pale in color as *plumosa*, but are





FIG. 5. Map showing the known distributions of *M. (Callimelissodes) metenua* Cockerell, *M. (C.) ablusa* Cockerell, and *M. (C.) minuscula* LaBerge.

readily distinguished from all species of the subgenus *Callimelissodes* by the weakly branched scopal hairs. The males are easily confused with those of either *metenua* or *plumosa*. The males of *clarkiae* are distinguished from those of *lupina* by the longitudinal, dorsolateral depressions of the flagellum being present on segments 3 through 10 and usually 11 as well. They can be separated from the males of *plumosa* and *metenua* by their shorter antennae, and specifically, by the penultimate flagellar segment being no more than twice as long as broad and usually shorter.

*Female.* Measurements and ratios: N, 7; length, about 11 mm.; width, about 3.5 mm.; wing length,  $M = 3.39 \pm 0.197$  mm.; hooks in hamulus,  $M = 11.71 \pm 0.286$ ; flagellar segment 1/segment 2,  $M = 2.02 \pm 0.038$ .

Structure and color: Integumental color as in *M. lupina*. Sculpturing and structure as in *lupina* with the following differences: clypeus with punctures smaller, round and regular in size, separated mostly by less than half a puncture width, surface dulled especially posteriorly by reticular shagreening, but moderately shiny; supraclypeal area shiny, delicately or not at all shagreened; flattened lateral areas of vertex with minute round punctures separated mostly by one to two puncture widths, surface shagreened; apical flagellar segment distinctly longer than broad, rounded apically; maxillary palpal segments in ratio of about 3.2:3.2:3.4:1.0, palpi longer in total length than in *lupina*; galeae moderately shiny above, dulled by finely reticular shagreening, usually less so in apical third. Mesoscutum not shagreened laterally and anteriorly, usually with small posteromedian impunctate area; metanotum often with dorsomedian area shiny, unshagreened; mesepisternum with lateral surface slightly or not at all shagreened, punctures round, deep, separated mostly by half a puncture width. Metasomal tergum 2 with basal area with minute round punctures separated mostly by more than one puncture width and often by more than two puncture widths, interband zone with punctures separated mostly by one to two puncture widths, not much sparser medially than laterally, apical area impunctate; tergum 3 with narrow apical area impunctate; pygidial plate U-shaped with arms diverging in basal half or less and subparallel apically.

Hair: On head and thorax cinereous except dark brown on vertex, mesoscutum with large posteromedian brown patch extending forward to a line at anterior margins of tegulae or almost so, and scutellum brown medially. Vestiture of metasoma as in *M. lupina*

except as follows: metasomal terga 2 and 3 with apical areas with suberect hairs more abundant; tergum 3 separated from apical margin across all or most of tergum; tergum 4 without suberect simple hairs medially near apical margin; terga 5 and 6 with hairs pale brown except large lateral cinereous tufts; sternal hairs golden brown medially to white laterally. Legs with white or pale ochraceous hairs except as follows: fore basitarsi and often distitarsi and often middle and hind basitarsi dark brown; fore and middle tibiae and middle basitarsi with inner surfaces yellow to red; hind basitarsi and tibiae with inner surfaces yellow to reddish-orange; scopal hairs white except pale brown on and near basitibial plates, with rachises extending far beyond plumose part, with branches sparse, usually one or two on each side of rachis, and long.

*Male.* Measurements and ratios: N, 10; length, 8-11 mm.; width, 2.0-2.5 mm.; wing length,  $M = 2.90 \pm 0.253$  mm.; hooks in hamulus,  $M = 10.60 \pm 0.267$ ; flagellar segment 2/segment 1, (9)  $M = 3.46 \pm 0.100$ .

Structure and color: Integumental color as in *M. lupina* except as follows: labrum narrowly margined by dark brown; clypeus lemon-yellow with extremely narrow, dark brown posterior zone (darkened especially at posterolateral angles).

Structure and sculpturing as in *lupina* except as follows: eyes slightly less than three-eighths as wide as long; minimum length of first flagellar segment more than one-fifth maximum length of second segment, often ratio equals one-fourth or greater; antennae short, in repose not quite reaching pterostigma; flagellar segments 3 through 10 (and often base of 11) with longitudinal, dorsolateral, shiny depressions; penultimate flagellar segment no longer than twice width and usually slightly less, maxillary palpal segments in ratio of about 5:4:4:1, last segment often shorter; clypeus with punctures round, separated mostly by half a puncture width or less (slightly more posteromedially), surface dulled by reticular shagreening; supraclypeal area usually sparsely shagreened; galeae shiny above with fine reticular shagreening in basal half to two-thirds. Sculpturing of metasomal terga much as in female, but tergum 1 with basal four-fifths punctate; sternum 4 with apical broad flap not, or extremely shallowly, emarginate medially.

Sternum 7 as in *plumosa*, but median plate with fewer hairs ventrally and membranous area below median plate and mesad of inner margin of lateral plate reduced in size. Sternum 8 as in *plumosa* but medioventral tubercle usually not bidentate but

rounded apically, usually with several minute hairs along distal margin. Genital capsule essentially as in *plumosa* but spatha with apical margin usually less sinuate (Figs. 50-53).

Hair: Vestiture as in *M. lupina* except as follows: pale hairs of head and thorax cinereous; vertex usually and mesoscutum often without brown; metasomal terga 6 and 7 with hairs golden-yellow to golden-brown.

*Bionomics.* In spite of the paucity of data it is apparent that *M. clarkiae* is an oligolectic bee restricted to plants of the family Onagraceae for its pollen. The scopal hairs of the female, each with only two to four long, slender branches, is admirably adapted to

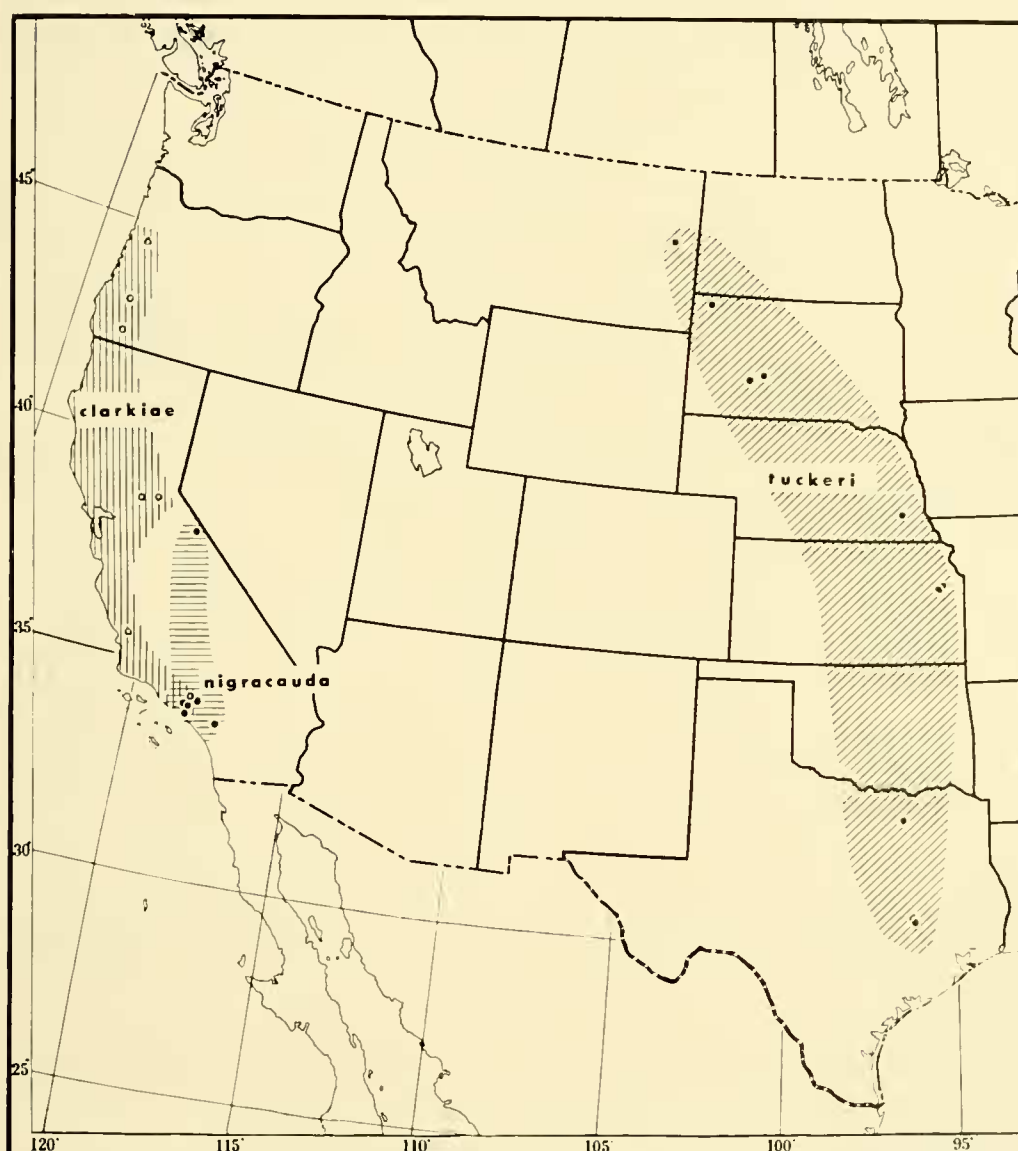


FIG. 6. Map showing the known distributions of *M. (Callimelissodes) clarkiae* LaBerge, *M. (C.) tuckeri* Cockerell, and *M. (C.) nigrauda* LaBerge.



carrying either the cobwebby type of pollen (as in *Oenothera*) or the tetrahedron type (as in *Clarkia* or *Godetia*). It would be difficult to conceive of such scopal hairs as serving to carry the composite pollens or other small, round, dry pollens. Of the seven females available for study the holotype was collected on *Clarkia* and bears its pollen in its scopae, five females bear only *Clarkia*-type (or the tetrahedron) pollen in their scopae and a single female bears the cobwebby type of pollen with a few grains of presumably *Clarkia* pollen intermixed.

*Type Material.* Holotype female, allotype male and ten male paratypes were collected by E. G. Linsley eight miles west of Atascadero, San Luis Obispo County, California, July 3, 1956, on *Clarkia speciosa speciosa*. In addition 6 females and 2 male paratypes are as follows: CALIFORNIA: Folsom, 1 female, May 30, 1952, T. R. Haig; Snowline Camp, Eldorado Co., 1 male, July 20, 1948, P. D. Hurd; Tanbark Flat, Los Angeles Co., 2 females, July 14, 1950, W. C. Bentinck. OREGON: Corvallis, 1 female and 1 male, July 19, 1933, Joe Schuh; Grants Pass, 1 female, July 12, 1935; Roseburg, 1 female, June 28, 1925 (distribution map, Fig. 6). The holotype and allotype are in the collection of the University of California at Berkeley. Paratypes are in the collections of the University of California at Berkeley, Oregon State College at Corvallis, the Snow Entomological Museum of the University of Kansas at Lawrence, Dr. J. G. Rozen and in the author's collection.

*Melissodes (Callimelissodes) ablusa* Cockerell

*Melissodes metenua ablusa* Cockerell, 1926, Pan-Pacific Ent., vol. 3, p. 85.

This species is closely related to the preceding four species and most closely resembles *metenua* in the dark color of the vestiture. The females of *ablusa* can be separated from those of *metenua* and *plumosa* by the densely tessellate galeae, the more densely punctate metasomal terga, the small size and the usual dark hair color. The males of *ablusa* are like those of *clarkiae* in that flagellar segments 4 to 10, and often 3 and 11, have the dorsolateral, longitudinal depressions and the penultimate flagellar segment is no more than twice as long as wide. The males of *ablusa* can be separated from those of *clarkiae* by the densely and regularly tessellate galeae and by the sculpturing of the terga as described below.

Cockerell did not have the male of this species when he first proposed the name. The male described below was not collected with any females and is considered to be the male of *ablusa* on the

basis of structure and color. This association of sexes is, therefore, provisional.

*Female.* Measurements and ratios: N, 9; length, 9-11 mm.; width, 3.5-4.0 mm.; wing length,  $M = 2.73 \pm 0.199$  mm.; hooks in hamulus,  $M = 11.22 \pm 0.223$ ; flagellar segment 1/segment 2,  $M = 2.12 \pm 0.042$ .

Structure and color: Integument as in *lupina* except eyes green to yellowish green, wing membranes slightly infumate and tibial spurs yellow to reddish brown. Structure and sculpturing as in *lupina* except as follows: clypeus with punctures crowded, small, regularly round, separated by less than half a puncture width except at extreme base medially; supraclypeal area shiny, unshagreened; flattened areas of vertex near apices of compound eyes with small round punctures separated mostly by less than half a puncture width; apical flagellar segment distinctly longer than broad, rounded distally; maxillary palpal segments in ratio of about 6:5:5:1; galeae narrow, surface opaque, dulled by dense, regular coarse tessellation. Mesoscutum with large posteromedian area impunctate (area about one-third of total surface), punctures surrounding impunctate area small; scutellum with punctures sparse medially, separated mostly by more than one puncture width; metanotum shiny medially; mesepisternum with lateral surface with punctures smaller than mesoscutal punctures, crowded, separated by half a puncture width or less, surface moderately shiny to dull, shagreened. Metasomal tergum 1 with basal half with crowded, shallow punctures, surface shiny to moderately so, with extremely fine reticulotransverse shagreening; tergum 2 with interband zone with deep, round, regular punctures separated by one-half to one puncture width, apical area with abundant, deep, round punctures separated mostly by one-half to one puncture width except narrow apical impunctate area, surface shiny, with extremely fine reticulotransverse shagreening; tergum 3 and 4 similar to tergum 2 but apical area obliterated or almost so by distal pubescent area; pygidial plate narrow, U-shaped, sides subparallel in apical half.

Hair: Darkest specimen as follows: head all black; thorax dark brown except sparse pale brown to ochraceous hairs surrounding wing base and dorsally on metanotum and propodeum; metasoma all dark brown except tergum 2 with basal zone with pubescence ochraceous, with broad, lateral oblique fasciae of pale pubescence (fasciae may almost meet medially and may reach apical margin

laterally but, if so, dark brown medially and apicolaterally), tergum 3 with distal pale pubescent band interrupted medially by brown pubescence and separated from apical margin across entire tergum by dark brown pubescence and suberect hairs, tergum 4 with apical pale pubescent band dark brown (or pale brown laterally only); terga 5 and 6 without pale hairs laterally; leg hairs dark brown except scopal hairs yellowish white. Palest specimens as in *M. lupina* except as follows: face except clypeus dark brown mixed with pale ochraceous (brown especially along inner margins of eyes, surrounding antennal fossa and surrounding supraclypeal area); metasomal terga 2 and 3 with distal pale bands narrowly interrupted medially; tergum 4 with median third with narrow dark brown pubescent area along apical margin and with scattered brown pubescence in pale band basal to this; tergum 5 with small lateral pale tufts; sternal hairs brown except at extreme apical margins of sterna 3 to 5 and at extreme sides; coxae, trochanters and femora brown, hind tibiae and basitarsi with inner surfaces dark brown, fore and middle tibiae and tarsi dark brown except outer apical surfaces of tibiae. Intermediate specimens mostly similar to darkest form; pale color progresses as described for *M. metenua* except head usually with more pale present and darkens concurrently with thorax.

*Male.* Measurements and ratios: N, 1; length, about 10 mm.; width, about 3 mm.; wing length, 5.19 mm.; hooks in hamulus, 11; flagellar segment 2/segment 1, 4.57.

Structure and color: Integumental color as in *M. lupina* except as follows: clypeus and mandibular base cream-colored, almost as pale as labrum; eyes gray. Structure as in *M. lupina* except as follows: flagellar segments 3 to 10 and base of 11 with ventrolateral, shiny, longitudinal depressions, penultimate segment twice as long as wide, ultimate segment much less than three times as long as wide; maxillary palpal segments in ratio of 2.2:2.0:2.0:1.0. Apical margin of sternum 4 not emarginate medially. Sculpturing as in female except as follows: clypeal punctures slightly coarser and more widely spaced: mesepisternum with lateral surface shiny, only sparsely shagreened; metasomal tergum 1 with basal four-fifths densely and regularly punctate; terga 2 to 4 with apical areas not punctate.

Sternum 7 as in *M. plumosa* but membranous area between inner edge of lateral plate and lower part of median plate almost obliterated, linear. Sternum 8 as in *plumosa* but apicoventral tubercle not bidentate, rounded apically and slightly surpassing apical margin



medially, without median apical hairs. Genital capsule as in *M. plumosa*.

**Hair:** Vestiture of head and thorax pale ochraceous (yellowish on dorsum of thorax) except sparse brown hairs medially on scutellum. Metasomal vestiture as in *M. lupina* except as follows: terga 1-3 without short brown hairs apically; tergum 2 with suberect hairs of interband zone ochraceous; terga 2 and 3 with apical areas glabrous; terga 4 and 5 with distal pale bands continuous, reaching apical margin except medially; terga 6 and 7 with dark brown hairs.

**Remarks.** As stated in the diagnosis, the male described here is provisionally associated with this species. It is similar to the females in regard to the sculpturing of the galeae, clypeus, mesoscutum, scutellum and metasoma. However, this male is extremely similar to the male of the next species described below which is very closely related to *M. ablusa*, according to the structural characters of the females.

**Type Material.** Holotype female collected by E. C. Van Dyke at Millbrae, California, September 1, 1912. Cockerell (1926) mentions seven female paratypes collected with the holotype, but I have been able to see only three of these paratypes. Also examined were six additional females collected with the holotype, but not recorded by Cockerell, one female collected by E. C. Van Dyke at Millbrae on October 3, 1926, and one male collected by R. M. Bohart, July 23, 1953, at Bolinas, California (see Fig. 5 for distribution map). The holotype is in the collection of the California Academy of Sciences in San Francisco. Paratypes are in the collections of P. H. Timberlake at the Citrus Experiment Station in Riverside, California, and in the U. S. National Museum. The single male described above is in the collection of the University of California at Davis.

*Melissodes (Callimelissodes) minuscula* n. sp.

This small species is closely related to *M. ablusa* Cockerell and perhaps is only a color variety of the latter. However, *minuscula* is relatively uniform in color and does not show evidence of grading toward the darker *ablusa*. Furthermore, *minuscula* shows some differences from *ablusa* in sculpturing, as described below. Both sexes of *minuscula* can be distinguished from the other members of the subgenus *Callimelissodes* in the same manner as *M. ablusa* except for the pale vestiture of *minuscula*.



*Female.* Measurements and ratios: N, 20; length, 9-10 mm.; width, 2.5-3.5 mm.; wing length,  $M = 2.50 \pm 0.085$  mm.; hooks in hamulus,  $M = 11.20 \pm 0.186$ ; flagellar segment 1/segment 2,  $M = 2.15 \pm 0.026$ .

Structure and color: Integumental color as in *lupina*. Structure and sculpturing as in *ablusa* except as follows: clypeus often with an indistinct longitudinal median carina; maxillary palpal segments in ratio of about 7:5:4:1, last segment often slightly longer; galeae tessellate as in *ablusa*; mesoscutal punctures surrounding impunctate posteromedian area large and deep, between impunctate area and parapsidal line separated mostly by one-half to one puncture width; mesepisternum with punctures as large as mesoscutal punctures, separated mostly by less than half a puncture width, surface shiny, unshagreened; metasomal tergum 2 with apical area impunctate except medially where pubescent band is interrupted, here punctures large, shallow, separated mostly by one to two puncture widths, surface moderately shiny; tergum 3 with interband zone with dense, regular, round punctures separated by less than half a puncture width; pygidial plate narrowly U-shaped, sides subparallel in apical third, occasionally narrowly V-shaped when worn.

Hair: Vestiture uniformly white except as follows: vertex with abundant dark brown; mesoscutal pale hairs pale ochraceous, dark patch not extending forward beyond a transverse line at about middle of tegulae; scutellum with sparse dark brown hairs medially; metasomal tergum 1 pale ochraceous in basal half, with sparse, simple, dark brown, minute, appressed hairs apically; tergum 2 with interband zone with brown suberect hairs at least medially, with pale distal pubescent band broad, reaching apical margin laterally, narrowly interrupted medially; tergum 3 with interband zone with diffuse white pubescence, basal zone with dark brown tomentum, distal pale band uninterrupted, reaching apical margin across most or all of tergum; tergum 4 dark brown basally, distal white pubescent band uninterrupted apicomediaally; terga 5 and 6 with pale brown to orange hairs (paler on tergum 6) medially and with large lateral white tufts equalling one-fourth to one-third of width of tergum; sternal hairs yellowish to brown medially; legs with dark brown to reddish brown hairs on fore tarsi and inner surfaces of hind basitarsi; scopal hairs highly plumose.

*Male.* Measurements and ratios: N, 10; length, 7-10 mm.; width, 2-3 mm.; wing length,  $M = 2.36 \pm 0.219$  mm.; hooks in hamulus,  $M = 10.30 \pm 0.300$ ; flagellar segment 2/segment 1, (9)  $M = 4.26 \pm 0.139$ .

Structure and color: Integumental color as in *M. lupina* except as follows: clypeus and mandibular base pale yellow to cream-colored; flagellum yellow below to dark red above; wing veins red to reddish brown. Structure as in *M. lupina* except as follows: eyes slightly more than three-eighths as broad as long; flagellar segments 3 to 10 and base of 11 with shiny, longitudinal, dorsolateral depressions, ultimate segment less than three times as long as broad, penultimate segment twice as long as broad or shorter; maxillary palpal ratio about 3.5:2.5:2.5:1.0. Apical margin of sternum 4 not emarginate medially or only extremely shallowly so. Sculpturing as in female with the following differences: supraclypeal area often dulled by sparse reticular shagreening; mesoscutum with postero-median impunctate area reduced or absent; metasomal tergum 1 with coarse punctures almost to apical margin medially but sparse in median third where punctures separated by 2 to 3 puncture widths; terga 2 and 3 with narrow apubescent apical areas (if present) impunctate.

Sternum 7 as in *M. plumosa* but membranous area between inner margin of lateral plate and base of median plate almost obliterated, linear. Sternum 8 as in *plumosa* but apicoventral tubercle rounded, not bidentate, and surpassing margin of sternum medially; with a few apicomedial hairs. Genital capsule as in *M. plumosa*.

Hair: Hair and pubescence pale ochraceous except as follows: yellowish ochraceous on vertex of head, mesoscutum and scutellum; metasomal terga 3-5 with tomentum at extreme base dark brown; tergum 2 with pale distal band reaching apical margin at least at sides, uninterrupted medially; terga 3 and 4 with pale distal bands reaching apical margins at least in lateral thirds, with diffuse pale pubescence in interband zones; terga 6 and 7 ochraceous to golden brown; basitarsi and distitarsi with inner surfaces yellow to red (red especially on fore and middle basitarsi).

*Type Material.* Holotype female, allotype male and 10 female paratypes were collected by R. R. Snelling near the San Joaquin River, 10 miles S. W. of Turlock, Stanislaus County, California, on July 13, 1952. Additional paratypes include 17 females and 9 males from California as follows: Avon, Contra Costa County: 3 males, August 29, 1937, E. C. Van Dyke. Bakersfield, Kern County: 1 male, July 24, 1929, R. H. Beamer. Kaweah, Tulare County: 1 male, June 19, 1936, F. T. Scott. Kern County: 1 male, June 19, 1936, F. T. Scott. Ridge Route, Los Angeles County: 1 male, June 13, 1931, H. A. Scullen. Tracy, San Joaquin County: 2 males, June

21, 1949, Ray F. Smith. Turlock (10 miles S. W. of, near San Joaquin River): 2 females, July 31, 1952, R. R. Snelling; 1 female on *Cressa cretica*, August 6, 1951, R. R. Snelling; 5 females on *Cressa cretica*, July 28, 1953, R. R. Snelling; 7 females on *Heliotropium curassavicum*, August 6, 1951, R. R. Snelling; 2 females, August 6, 1951, R. R. Snelling (distribution map, Fig. 5).

The holotype and allotype are in the collection of the California Academy of Science at San Francisco. Paratypes are in the collections of R. R. Snelling, Turlock, California, the Snow Entomological Museum of the University of Kansas, Lawrence, P. H. Timberlake of the Citrus Experiment Station, Riverside, California, the University of California at Berkeley, the California Academy of Sciences at San Francisco, Oregon State College at Corvallis and in the author's collection.

*Melissodes (Callimelissodes) tribas*, n. sp.

*M. tribas* is a small species known from a single female from San Diego, California. It is closely related to *M. minuscula* which it resembles in color and to *M. ablusa*. *M. tribas* can be distinguished from *ablusa* by its paler vestiture and from *minuscula* by its larger size, pale hairs of the inner surfaces of the hind basitarsi, and darker thoracic hairs.

*Female.* Measurements and ratios: N, 1; length, about 9.5 mm.; width, about 3.5 mm.; wing length, 2.92 mm.; hooks in hamulus, 13; flagellar segment 1/segment 2, 2.00.

Structure and color: Integumental color as in *lupina* but eyes gray-green. Structure and sculpture as in *minuscula* except as follows: clypeus without apicomedian carina; maxillary palpal ratio about 2.7:1.3:1.3:1.0; galeae tessellate as in *ablusa*; mesoscutal punctures surrounding posteromedian impunctate area large, deep, surface shiny; tergum 1 with basal three-fifths with deep, round punctures separated mostly by half a puncture width; tergum 2 with apical area absent, surface beneath apical pubescent band with small, round punctures separated by two to three puncture widths; pygidial plate U-shaped in apical half, narrow, sides diverging basad.

Hair: Vestiture as in *minuscula* except as follows: mesoscutal pale hairs dark ochraceous, dark brown posteromedian patch rounded, twice area of scutellar dark patch or slightly more, extending forward beyond a transverse line at anterior margins of tegulae; tegulae without brown; metasomal tergum 2 with distal pale band uninterrupted, apical, interband zone with some short,



suberect, brown, simple hairs at least medially; tergum 5 brown basally, yellow-orange apicomediaally, white laterally; tergum 6 orange medially to white laterally; sternal hairs yellow medially, white laterally; inner surfaces hind basitarsi orange; scopae white.

*Type Material.* The holotype female from San Diego, California, June 5, 1913, is in the collection of Cornell University, Ithaca, New York.

*Melissodes (Callimelissodes) nigracauda*, n. sp.

This strikingly colored bee is very distinct and not closely related to any other of the species of this subgenus. It resembles *M. ablusa* and *M. minuscula* in the sculpturing of the galeae in both sexes and in the color of the male clypeus. The females are readily recognized by the vestiture of the head, abdomen and sides of the thorax being dark brown to black, whereas the dorsum of the thorax is ochraceous to slightly rufescent. In addition, the scopal hairs are dark brown to black. The males can be separated from males of other species of the subgenus by the long first flagellar segment and by the flattened condition of the flagellar segments as described below. In addition the terminalia are highly distinctive.

*Female.* Measurements and ratios: N, 20; length, 11-13 mm.; width, 3.5-4.5 mm.; wing length,  $M = 3.86 \pm 0.102$  mm.; hooks in hamulus,  $M = 14.20 \pm 0.275$ ; flagellar segment 1/segment 2,  $M = 2.24 \pm 0.241$ .

Structure and color: Integument black except as follows: flagellar segments 4 (and often 3) to 10, distitarsi, apical half of mandibles and often hind and middle tibial spurs (black in holotype) rufescent; wing membranes infumate, brown. Clypeus with round punctures somewhat elongate apicomediaally, separated mostly by one-half to one puncture width, surface moderately shiny, with sparse cross-striations; supraclypeal area shiny, unshagreened or sparsely so; galeae dulled by dense, coarse, regular tessellation; maxillary palpal segments in ratio of about 9:9:8:1, last segment often slightly longer; eyes more than three times as long as broad; vertex with flattened area apicomediaad of compound eyes with small round punctures separated by less than one puncture width, surface shiny; ultimate flagellar segment longer than broad. Mesoscutum with small round deep punctures separated mostly by one puncture width at level of parapsidal lines, more crowded anteriorly and lateral to parapsidal lines, sparser in posteromedial area, surface shiny, unshagreened; scutellum punctate as on mesoscutum at level of parapsidal lines, unshagreened; metanotum with



round punctures smaller than on scutellum and separated by less than one puncture width, shiny and sparsely shagreened at least dorsally; propodeum much as in *M. lupina*, but surface moderately shiny, shagreening delicate; mesepisternum with lateral surface with regular round punctures slightly smaller than those of postero-median area of mesoscutum and separated by one-half to one puncture width, surface unshagreened. Metasomal tergum 1 with basal half with punctures sparse, extremely shallow and indistinct, apical half impunctate, surface dulled by fine, dense, reticulotransverse shagreening, moderately shiny; tergum 2 with basal zone punctures minute, separated by three to four puncture widths, interband zone with indistinct, sparse punctures, apical area impunctate, surface shiny (basal zone) to moderately shiny, shagreened as in tergum 1; terga 3 and 4 as in tergum 2; pygidial plate broadly V-shaped, apex quite pointed.

Hair: Head dark brown to black, occasionally a few pale hairs on vertex and near antennal fossae; thorax with mesoscutum, scutellum, tegulae and dorsal surface of propodeum ochraceous to slightly rufescent, remainder dark brown to black; abdomen dark brown to black except as follows: metasomal tergum 1 often with long pale hairs mixed with dark in basal half (a few pale in holotype); terga 2 and 3 with apical areas with minute, simple, closely appressed, sparse, dark brown hairs; tergum 3 with distal pubescent band often ochraceous in lateral thirds or less (dark brown in holotype); legs with hairs dark brown to black except scopal hairs of tibiae brown to dark brown medially (in holotype basitarsi and tibiae with brown hairs).

*Male.* Measurements and ratios: N, 20; length, 11-14 mm.; width, 2.5-4.0 mm.; wing length,  $M = 3.74 \pm 0.208$  mm.; hooks in hamulus,  $M = 12.90 \pm 0.204$ ; flagellar segment 2/segment 1,  $M = 3.27 \pm 0.042$ .

Structure and color: Integument black except as follows: clypeus and base of mandible pale yellow to cream-colored; labrum white with narrow apical margin of brown; eyes gray to bluish gray; flagellum except first segment yellow to red below; wing membranes slightly infumate, yellowish, veins dark reddish brown to black; tibial spurs yellow to yellowish brown.

Minimum length of first flagellar segment equals one-fourth or more of maximum length of second segment, ultimate and penultimate segments at least three times as long as broad, flagellum with dorsolateral depressions absent, but shiny areas present on seg-

ments 5 through 11 (and often at base of 4) and these segments distinctly compressed. Maxillary palpal segments in ratio of about 2.50:5.00:2.75:1.00. Sculpturing as in female but metasomal tergum 1 with basal two-thirds to three-fourths punctate and terga 4 and 5 similar to tergum 3. Sternum 4 with apical margin broadly convex and often with extremely shallow emargination medially; sterna 3 and 5 with margins convex, but only slightly so and not apparent if abdomen telescoped.

Sternum 7 with median plate about twice as broad as long, supported by narrow neck at least as long as plate, plate with minute hairs covering all of ventral surface, neck with sparse longer hairs; lateral plate with pronounced proximolateral angle; membranous area small. Sternum 8 with apex truncate, scarcely if at all emarginate medially; ventral tubercle pointed, with minute notch at apex, reaching or slightly surpassing apical margin of sternum. Gonostylus longer than one-half of length of gonocoxite, club-shaped in dorsal view, flattened, apical fourth broader than basal fourth, with minute pointed spicules near base ventrally; gonocoxite with spicules on inner surface at apex (just proximad of gonostylus) mostly long, thick, obtuse; penis valve with dorsal lamella ending anteriorly near spatha in inturned angle or tooth; spatha about 3 times as wide as long, apical margin sinuate (Figs. 54-57).

Hair: Head and thorax ochraceous (slightly darker on mesoscutum and scutellum). Abdomen ochraceous except as follows: tergum 1 with apical area with short, dark brown, appressed hairs; terga 2 to 4, and often medially on 5, with apical areas with short, appressed to subappressed, dark brown, simple hairs; terga 3 to 5 with basal zones with dark brown tomentum; sterna with brown to yellow hairs medially, pale ochraceous laterally. Leg hairs ochraceous except inner surfaces of tarsi golden yellow to orange.

*Type Material.* Holotype female, allotype male, and thirteen female and three male paratypes were collected by C. D. Michener on *Stephanomeria* sp. at Altadena, California, on September 28, 1935. Seven female and fourteen male paratypes in addition were collected by C. D. Michener at Altadena, California, as follows: 1 male on *Senecio douglasii*, August 2, 1934; 4 females and 12 males on *Stephanomeria* sp., September 13, 1934; 1 female and 1 male on *Stephanomeria* sp., September 30, 1934; 1 female on *Stephanomeria virgata*, August 19, 1935; 1 female on *S. virgata*, August 29, 1935. In addition 10 female and 3 male paratypes were collected in California as follows: Alcalde (Diablo Mt.), 1 female, August 6, 1927;

Boquet Canyon, Angeles National Forest, 1 male on *Erigeron* sp., August 23, 1954, R. R. Snelling; Hot Creek, Mono County, 1 female, July 17, 1953, R. M. Bohart; Pasadena, 3 females and 1 male on *Stephanomeria* sp., September 11, 1934, C. D. Michener; Redondo Beach, Los Angeles County, 1 male, July 20, 1937; Riverside, all on *Stephanomeria exigua* by P. H. Timberlake: 1 female on September 20, 1932, 2 females on September 1, 1933, 1 female on September 12, 1933, and 1 female on September 18, 1933. The holotype and allotype are in the Snow Entomological Museum at the University of Kansas, Lawrence (distribution map, Fig. 6). Paratypes are in the collection of the Snow Entomological Museum, the University of California at Davis, P. H. Timberlake at the Citrus Experiment Station, Riverside, California, R. R. Snelling of Turlock, California, Cornell University, Ithaca, N. Y., the U. S. National Museum, and in the author's collection.

*Remarks.* It seems likely that this species is restricted to plants of the genus *Stephanomeria* (Compositae) for sources of pollen. However, the data are as yet too sparse to come to a firm conclusion regarding oligolecty. It is perhaps significant that the only other plants from which *nigracauda* has been collected are also composites (*Erigeron* and *Senecio*).

*Melissodes (Callimelissodes) composita* Tucker

*Melissodes lupina* var. *composita* Tucker, 1909, Trans. Kansas Acad. Sci., vol. 22, p. 281.

*Melissodes lupina*, Cockerell, 1909, Trans. Kansas Acad. Sci., vol. 22, p. 305 (misidentification).

Among the foregoing species, *M. composita* is most closely related to *M. plumosa* and *M. metenuea*. Both sexes can be distinguished by their relatively shiny galeae, coarsely punctate mesoscutum and scutellum and highly shiny and glabrous apical areas of the terga. The females are distinctive in that the first metasomal tergum has the basal punctures crowded in the basal third or less and absent or scattered apical to this and the second tergum with the interband zone with only scattered punctures medially. The males are distinctive in that the metasomal terga 2 to 4 have the apical areas glabrous and shiny, the antennae as in *M. plumosa*, but the third segment lacks the dorsolateral depression, and coarse punctation on the mesoscutum as described below.

*Female.* Measurements and ratios: N, 20; length, 9.5-11.0 mm.; width, 3.0-4.5 mm.; wing length,  $M = 3.43 \pm 0.118$  mm.; hooks in



hamulus,  $M = 12.40 \pm 0.161$ ; flagellar segment 1/segment 2,  $M = 1.94 \pm 0.025$ .

Structure and color: Integumental color as in *M. lupina*. Structure and sculpturing as in *lupina* except as follows: clypeus and supraclypeal area with surfaces shiny, with extremely sparse shagreening if any; flattened areas of vertex posteromesad of compound eyes with sparse, minute punctures separated by two to four puncture widths, surface shiny to moderately so, dulled by distinctly reticular shagreening; apical flagellar segment longer than broad; maxillary palpal segments in ratio of about 4:3:3:1; galeae above with surface shiny to moderately shiny, with reticular, delicate shagreening at least in apical half; mesoscutum with large coarse punctures, in area mesad of parapsidal lines separated mostly by less than half a puncture width and larger than scutellar or mesepisternal punctures, laterad of parapsidal lines slightly smaller and separated by less than half a puncture width, posteromedian area impunctate, surface somewhat dulled by delicate reticular shagreening, especially anteriorly and laterally; scutellum with crowded punctures and delicate shagreening; mesepisternum with lateral surface punctures slightly smaller than largest mesoscutal punctures, surface shiny, slightly or not at all shagreened; metasomal tergum 1 with basal three-fifths punctate but punctures crowded only in basal fourth, elsewhere punctures separated mostly by two to four puncture widths, apical area impunctate, surface dulled by reticulotransverse shagreening; tergum 2 with basal zone with punctures separated by half a puncture width and surface dulled by reticular shagreening, interband zone with scattered punctures of irregular size, apical area impunctate, surface moderately shiny, with reticulotransverse shagreening; tergum 3 similar to tergum 2 but interband zone with distinct, round, regular punctures separated mostly by less than one puncture width; pygidial plate U-shaped with sides diverging towards base, sides subparallel in apical third (when not worn).

Hair: Head white to pale ochraceous except dark brown on vertex. Thorax pale ochraceous on lower lateral surfaces, ochraceous to yellow elsewhere except scutellum dark brown medially and mesoscutum with posteromedian dark brown patch which extends forward to a transverse line usually at about middle of tegulae. Metasomal tergum 1 ochraceous basally, glabrous apically; tergum 2 with pale ochraceous to white pubescence in basal zone connected by pale pubescence to short, pale, strongly oblique, lateral, pubes-



cent fasciae which quite or almost reach apical margin of tergum at extreme sides, apical area glabrous, interband zone with scattered, minute, pale brown, simple, suberect to appressed hairs, tergum 3 similar to tergum 2 but basal tomentum brown, apical area narrow (equals half of distal pale band medially), distal pale band uninterrupted medially and interband zone with diffuse, pale, appressed pubescence; tergum 4 similar to tergum 3 but distal pale band apical and never interrupted medially; terga 5 and 6 medially usually golden to pale brown and white at extreme sides; sterna with golden hairs medially to white laterally. Legs with hairs white except as follows: inner surfaces of tarsi yellow to orange; outer surface of fore basitarsi brown.

*Male.* Measurements and ratios: N, 17; length, 9-12 mm.; width, 2.5-3.5 mm.; wing length,  $M = 3.27 \pm 0.116$  mm.; hooks in hamulus,  $M = 11.31 \pm 0.198$ ; flagellar segment 2/segment 1,  $M = 5.05 \pm 0.143$ .

Structure and color: Integumental color as in *M. lupina* but apical areas of terga usually somewhat translucent, yellowish brown to brown. Structure as in *lupina* except as follows: flagellar segments 4 to 10 with longitudinal dorsolateral shiny depressions, minimum length of first flagellar segment equals more than one-fifth of maximum length of second segment, ultimate segment about three times as long as broad, penultimate segment more than twice and less than three times as long as broad; maxillary palpal ratio about 4:3:3:1 or last segment shorter; galeae moderately shiny above, dulled by delicate shagreening at least in apical half; apical margin of fourth sternum extremely broadly and shallowly emarginate or evenly convex. Sculpturing as in female except as follows: mesoscutum with posteromedian area often with scattered punctures; metasomal tergum 1 with basal four-fifths to five-sixths with coarse punctures irregularly spaced by less than one to three puncture widths; tergum 2 with interband zone with large round punctures separated mostly by one or less puncture widths, punctures as large as on base of tergum 1; tergum 3 similar to tergum 2 but punctures of interband zone more crowded; terga 4 and 5 similar to tergum 3.

Sternum 7 similar to that of *M. plumosa* with the following additions: median plate with apical margin transverse or almost so, with lateral concavity at side of neck about as long as median plate above the concavity; lateral plate with apicomedian edge expanded slightly so that it slightly surpasses apicolateral process; membranous area large, subtriangular (Fig. 58). Sternum 8 as in

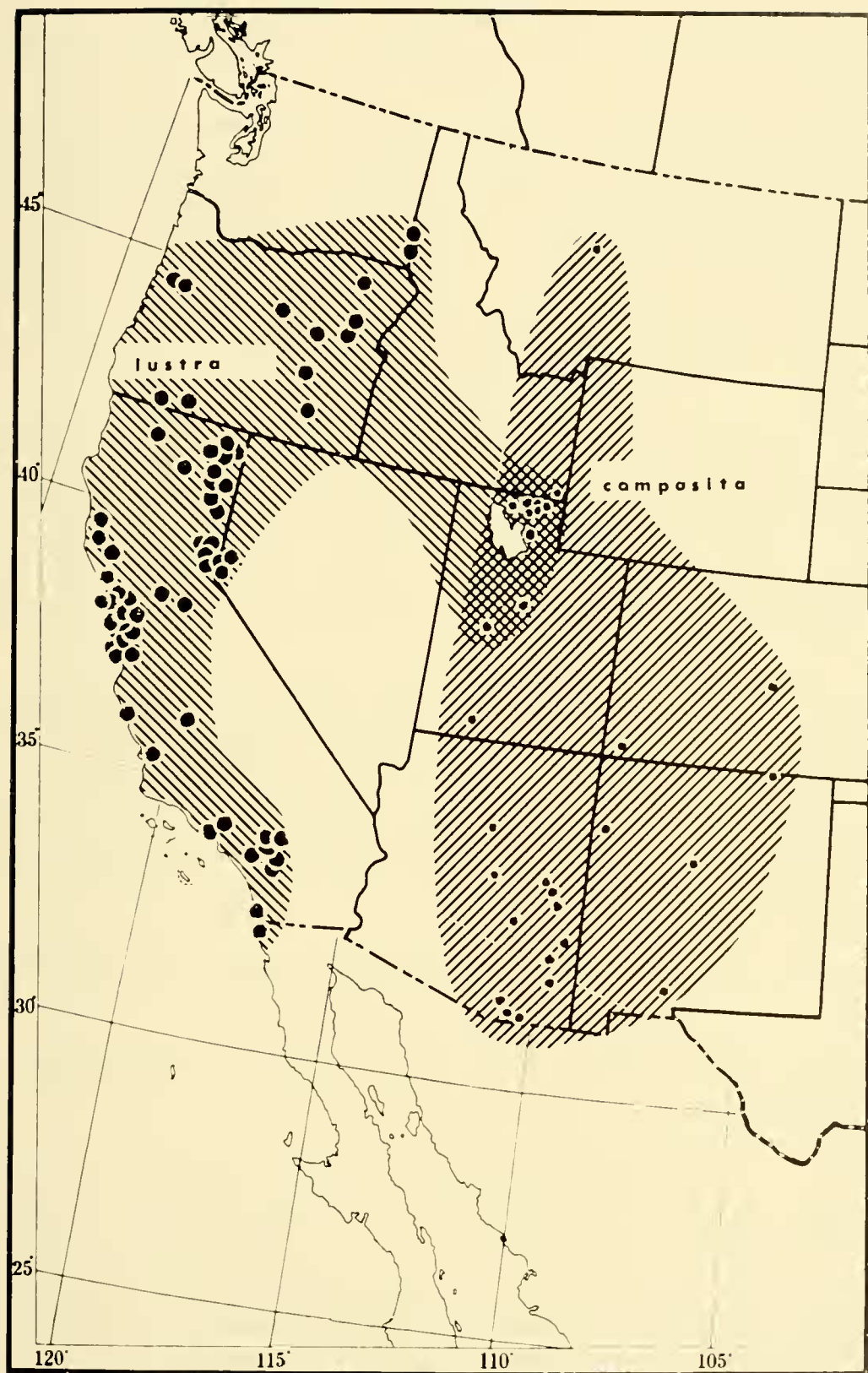


FIG. 7. Map showing the known distributions of *M. (Callimelissodes) lustra* LaBerge and *M. (C.) composita* Tucker.

*plumosa* but with several short, delicate hairs on apical margin at either side of median emargination. Genital capsule as in *plumosa*.

**Hair:** Head and thorax pale to dark ochraceous, usually darker on vertex of head and on dorsum of thorax. Metasomal terga white to ochraceous with the following additions: terga 2 to 4 with apical areas glabrous; tergum 5 with distal pubescent band usually reaching margin; terga 6 and 7 dark ochraceous to pale brown (brown especially basally and medially). Legs with pale ochraceous to white hairs except inner surfaces of tarsi yellow to pale orange.

**Type Material.** Holotype male and two male paratypes collected by E. S. Tucker at Colorado Springs, Colorado, at 5915 feet altitude, August, 1906. The holotype is in the U. S. National Museum (Type No. 12878) and the two paratypes are in the Snow Entomological Collection of the University of Kansas, Lawrence, Kansas. In addition to the type material, 57 females and 15 males from the localities listed below have been examined (Fig. 7). This list includes localities reported in the literature.

ARIZONA: Canelo; Flagstaff (3 miles N.W. and 7 miles S.); Globe; Granville (20 miles N.); Huachuca Mts.; Lakeside; McNary Junction, Apache Reservation (6 miles S.), Apache Co.; Pine; Safford (30 miles S.); Santa Rita Mts. COLORADO: Berkeley; Colorado Springs; Mesa Verde. IDAHO: Cub River Canyon; Franklin. MONTANA: Cascade Co. NEW MEXICO: Gallup; Las Cruces; Raton Pass; Sandia Mts. UTAH: Glendale; Green Canyon; Howell; Logan Canyon; Mendon; Mt. Nebo.

**Flower Records.** Not much data is available concerning the flower preferences of this species. This data, however, indicates a preference for plants of the family Compositae.

*Aster* sp., *Grindelia* sp., *G. squarrosa*, *Haplopappus gracilis*, *Thurberia thespesioides*.

*Melissodes (Callimelissodes) lustra*, n. sp.

This species is closely allied to *M. composita* Tucker. The females are distinguished from those of *composita* primarily by the less coarse punctation of the mesoscutum and first metasomal tergum. The males of *lustra* can be distinguished from those of *composita* by the less coarse sculpturing of the mesoscutum and by the shape of the median and lateral plates of sternum 7 as described below.

**Female.** Measurements and ratios: N, 20; length, 9-12 mm.; width, 3.0-4.5 mm.; wing length,  $M = 3.56 \pm 0.168$  mm.; hooks in



hamulus,  $M = 12.70 \pm 0.147$ ; flagellar segment 1/segment 2,  $M = 2.05 \pm 0.027$ .

Structure and color: Integumental color as in *lupina* except eyes yellowish green to green. Sculpturing and structure as in *composita* with the following differences: supraclypeal area often dulled by reticular shagreening; maxillary palpal segments in ratio of about 2:2:2:1; mesoscutum with punctures mesad of parapsidal lines small to minute, separated mostly by more than one puncture width (often by three or four puncture widths), punctures laterad of parapsidal line small, separated by one-half to one puncture width, posteromedian impunctate area large; scutellar punctures irregular in size, medially separated by one-half to two puncture widths; mesepisterna with punctures shallow, as large or larger than mesoscutal punctures mesad of parapsidal lines, surface dulled by fine shagreening; metasomal tergum 1 with basal sixth with crowded punctures, from basal sixth to about three-fifths of median length with scattered punctures separated by two to four puncture widths, apical area impunctate; tergum 2 with basal zone punctures minute, separated mostly by one puncture width and surface shiny, interband zone with scattered, irregular-sized punctures, apical area impunctate, surface moderately shiny, reticulotransversely shagreened; tergum 3 similar to tergum 2 but interband zone punctures sparser than in *composita*, medially separated mostly by two or more puncture widths; pygidial plate narrow, U-shaped with sides subparallel in apical third (somewhat V-shaped when worn near tip).

Hair: Hair color as in *composita* with the following additions: head often with dark brown mixed with pale on face along inner margins of compound eyes (as in holotype) to occasional specimens in which head all dark brown except golden on labrum; thorax often with a few long brown hairs mixed with the pale on pronotum (as in holotype) and especially on posterior pronotal lobes to occasional specimens in which lateral surfaces of thorax and pronotum with all hairs dark brown to black and dark mixed with the pale on anterior and lateral parts of mesoscutum; metasomal terga 5 and 6 occasionally with median hairs dark brown (golden in holotype and in most specimens, even on some in which the head and thorax are mostly dark); legs with hairs as in *composita* (and in holotype of *lustra*) but darkest specimens with coxae, trochanters, femora and fore tibiae pale brown and inner surfaces of hind basitarsi red.

*Male.* Measurements and ratios: N, 20; length, 9-12 mm.; width, 2.5-3.5 mm.; wing length,  $M = 3.31 \pm 0.153$  mm.; hooks in hamu-



lus,  $M = 11.95 \pm 0.185$ ; flagellar segment 2/segment 1,  $M = 3.45 \pm 0.067$ .

Structure and color: Integumental color as in *composita* but eyes yellowish green. Structure and sculpturing as in *composita* with the following differences: minimum length of first flagellar segment equals one-third to one-fourth maximum length of second segment (one-third in allotype); maxillary palpal segments in ratio of about 3.0:3.0:2.5:1.0; mesoscutum with punctures smaller and sparser, mesad of parapsidal lines separated by one to two puncture widths; mesepisternum with surface dulled by reticular shagreening; metasomal tergum 1 with basal four-fifths or less punctate; tergum 2 with basal zone punctures separated mostly by one or more puncture widths; interband zone punctures small, irregular, separated by one-half to three puncture widths; tergum 3 with interband zone punctures small, separated mostly by one to two puncture widths; tergum 4 as in tergum 3; terga 2 to 5 with apical areas shiny, with extremely delicate reticulotransverse shagreening.

Sternum 7 as in *composita* except as follows: median plate with apical margin oblique, slanting proximad towards outer side, with lateral concavity at side of neck small, deep, about half as long as plate above the concavity; lateral plate with apicomedian margin not expanded distad, but mesal margin in a rounded, continuous slope from apicolateral process mesally and proximally to membranous area (Fig. 59). Sternum 8 and genital capsule as in *composita*.

Hair: Vestiture of head and thorax cinereous to ochraceous and often brighter (even slightly rufescent) on vertex and dorsum of thorax. Abdominal and leg hairs and pubescence as in *composita*.

*Remarks.* Although a number of Californian specimens (all females) tend to be dark in vestiture color, these specimens are not so distributed geographically nor abundant enough to warrant recognition as a separate subspecies. The darkest females come from Millbrae in San Mateo County and Gazelle in Sonoma County and are only four in number. Other specimens with dark hairs scattered especially over the face and pronotum occur in several localities in California (including the type locality) and in Oregon.

*M. lustra* is extremely similar to *M. composita*. Also, the two species are largely allopatric in distribution, their ranges overlapping only in Utah and southern Idaho. These facts may suggest that *lustra* is nothing but a well-marked subspecies of *composita*. However, the fact that there are localities in Utah and in Idaho

in which both species have been collected at the same time without any obvious intergrades seems to provide convincing evidence that the two forms are distinct species.

*M. lustra* is an oligolectic bee depending upon plants of the family Compositae for pollen and, particularly, upon the genera *Gutierrezia*, *Chrysothamnus* and *Isocoma* in decreasing order of importance. Of 63 collections of bees in which the floral data is recorded, 61 are from one of 14 genera of composites. The other two collections consist each of a single male from a legume (*Melilotus alba*) and a euphorb (*Croton californicus*). Of the 44 collections of bees from composites, 17 were taken from flowers of species of *Gutierrezia*.

*Type Material.* The holotype female, allotype male and eleven female and one male paratypes were collected by C. D. Michener at Erwin Lake, San Bernardino Mts., California, on August 22, 1932. An additional male paratype was taken in the same locality by C. D. Michener on August 18, 1932. Additional paratypes from California include 33 females and 5 males as follows: Baldwin Lake, San Bernardino Co.: 3 females on *Chrysothamnus viridulus*, September 1, 1936, P. H. Timberlake. Big Bear Lake, San Bernardino Co.: 1 male, August 7, 1930, L. Wilson. Riverside, Riverside Co.: the following collected by P. H. Timberlake on *Gutierrezia sarothrae*: 1 female on October 17, 1924, 1 female on October 20, 1924, 1 female on October 9, 1925, 1 female on October 13, 1925, 3 females on October 22, 1925, 1 female on October 26, 1925, 1 female on October 27, 1925, 3 females on October 28, 1925, 3 females on November 4, 1925, 1 female on November 10, 1925, 1 female on November 16, 1925, 1 female on November 19, 1925, 1 female on October 24, 1927, 1 female on October 15, 1929, 1 female on October 16, 1929, 1 female on November 5, 1929; the following collected by P. H. Timberlake on *Gutierrezia californica*: 1 female on September 22, 1926; the following collected by P. H. Timberlake on *Ericameria palmeri*: 1 male on September 25, 1925, 1 female on November 6, 1928, 1 female on October 9, 1929, 2 males on October 28, 1929; the following collected by P. H. Timberlake on *Isocoma vernonioides*: 1 female on October 10, 1926, 1 female on October 31, 1932, 1 female on October 3, 1934; 1 female on October 20, 1951, P. D. Hurd. Whitewater, Riverside Co.: 1 male, October 27, 1934, A. L. Melander. Whitewater Canyon, Riverside Co.: 1 female on *Isocoma* sp., October 14, 1951, P. H. Timberlake. The holotype and allotype are in the Snow Entomological Museum of the Uni-

versity of Kansas, Lawrence. Paratypes are in the Snow Entomological Museum and in the collections of P. H. Timberlake, Citrus Experiment Station, Riverside, California, the University of California at Berkeley, the University of California at Davis, the Museum of Comparative Anatomy at Harvard University, Cambridge, Massachusetts, and in the author's personal collection.

*Distribution.* *M. lustra* occurs from Baja California in the southwest, north to Oregon and east to Utah and Idaho (Fig. 7). It has been collected between the dates of August 7 and November 19 (one label bears the month of July and the specimen was presumably taken near the end of that month). A total of 235 females and 182 males have been examined from the localities listed below (including type material).

CALIFORNIA: Alturas; Antioch; Avon; Baldwin Lake; Benecia; Berkeley; Big Bear Lake; Boca Dam (11 miles E. of Truckee); Brookway; Caliente Mt., San Luis Obispo Co.; Calpine; Canby; Capitola; Carbon; Cedar Pass, Modoc Co.; Deep Creek; Erwin Lake, San Bernardino Mts.; Gazelle; Halleleujah Junction, Lassen Co.; Hobart Mills; Kentfield; Lake City; Larkspur; Lemoore; Livermore; Los Angeles Co.; Lucia; Madeline (and 8 miles N.); Mason Creek Railroad Siding, Modoc Co.; McArthur; Mt. Tamaulpais; Murphys; Menlo Park; Millbrae; Palo Alto; Ravendale (8 miles S.); Riverside; Sacramento; San Diego; San Francisco Bay; San Jose; Sonoma Co.; Santa Clara Co.; Sierraville (and 8 miles N. W.); Soda Bay, Clear Lake; Standish (4 miles W.); Stanford University; Tesla; Truckee (2 miles N.); Ukiah; Vallejo; West Hollywood Hills; Westwood Hills; Whitewater; Whitewater Canyon. IDAHO: Cub River Canyon; Franklin; Lewiston; Moscow. NEVADA: Purdy; Reno (2 miles N.); Sparks (11 miles N.); Washoe City. OREGON: Antelope Mt., Harney Co.; Baker; Burns (23 miles E.); Corvallis; Elgin (3 miles S.); Hereford; Klamath Lake; Medford; Mitchell (14 miles E.); Prairie City; Tangent (5 miles E.). UTAH: Cache Junction; Delta; Honsel; Logan Canyon; Mendon; Ogden. Mexico. BAJA CALIFORNIA: Tijuana (32 miles S.).

*Flower Records.* *Aster* sp., *Baccharis pilularis*, *Biglovia* sp., *Chrysothamnus* sp., *C. nauseosus*, *C. nauseosus consimilis*, *C. nauseosus speciosus*, *C. v. viscidiflorus*, *C. viridulus*, *Croton californicus*, *Ericameria palmeri*, *Eriogonum latifolium*, *Grindelia* sp., *G. camporum*, *Gutierrezia californica*, *G. sarothrae*, *Haplopappus bloomeri angustatus*, *Helianthus* sp., *Heterotheca grandiflora*, *Isocoma* sp., *I. vernonioides*, *Melilotus alba*, *Senecio douglasii*.



*Melissodes (Callimelissodes) glenwoodensis* Cockerell

*Melissodes glenwoodensis* Cockerell, 1905, Ann. Mag. Nat. Hist., ser. 7, vol. 15, p. 522; 1905, Canadian Ent., vol. 37, p. 321; 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 107, 113; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309; 1927, Ann. Ent. Soc. Amer., vol. 20, p. 396.

This strikingly marked bee is closely related to *Melissodes lustra* from which it differs in both sexes primarily by its larger size. The females of *glenwoodensis* can be distinguished further by the dark reddish brown hairs on the inner surfaces of the hind basitarsi and tibiae. The males are distinguished from those of *lustra* by the lack of the longitudinal, dorsolateral depression on flagellar segment four and by usually having dark brown hairs on terga 6 and 7.

*Female.* Measurements and ratios: N, 20; length, 11-14 mm.; width, 4-5 mm.; wing length,  $M = 4.23 \pm 0.171$  mm.; hooks in hamulus,  $M = 14.15 \pm 0.233$ ; flagellar segment 1/segment 2,  $M = 2.04 \pm 0.022$ .

Structure and color: Integument black except distitarsi, apical half of mandible and lower surface of flagellar segments 3 to 10 rufescent, eyes gray to greenish gray and basitibial spurs red to yellow. Sculpturing and structure as in *composita* except as follows: clypeus with surface dulled by fine shagreening; supraclypeal area dulled by dense reticular shagreening; flattened area of vertex posteromesad of apex of compound eye with small punctures separated by one to two puncture widths, surface dulled by fine shagreening; galeae above dulled by reticular shagreening at least in apical half; maxillary palpal ratio about 2.0:2.0:1.5:1.0, with last segment sometimes slightly shorter; mesoscutum with large round punctures anteriorly and laterally, punctures just mesad and just laterad of parapsidal lines separated by one puncture width or less, surface with fine tessellation at least anteriorly, posteromedian area impunctate or with scattered punctures separated mostly by two or more puncture widths; scutellar punctures small, separated by one-half to two puncture widths; mesepisternal punctures shallow, round, separated by half a puncture width or less, surface dulled by tessellation; metasomal tergum 1 with crowded punctures in basal third or less, with scattered, minute punctures in middle third, apical area impunctate, surface reticulotransversely shagreened, shiny apically; tergum 2 with basal zone punctures minute, round, crowded, with interband zone punctures mostly minute, extremely sparse, with apical area impunctate, surface shiny, reticulotransverse shagreening extremely fine; tergum 3 similar to tergum 2 but interband zone punctures minute, round, separated by one to two



puncture widths, surface shiny (especially apical area); pygidial plate V-shaped with rounded apex.

Hair: Palest specimens with head white except a few brown hairs on vertex; darkest with abundant dark brown hairs on vertex and surrounding hairs ochraceous. Thorax of palest white below to pale ochraceous above; darkest pale ochraceous below to ochraceous above and mesepisternum with anterior surface dark ochraceous to brown. Metasomal tergum 1 with basal area and at extreme sides with white to pale ochraceous hairs; tergum 2 with basal pubescence white, with distal pubescent band restricted to narrow, lateral, oblique, white fasciae each equaling slightly more than apubescent median area in width and laterally separated from apical margin by at least length of fascia at that point; tergum 3 with basal tomentum dark brown, distal pubescent band white, separated from apical margin across entire tergum, interband zone with scattered pubescence brown to white (brown nearer base); tergum 4 with apical pubescent band white, uninterrupted medially, basal and interband zones as in tergum 3; terga 5 and 6 dark brown to black except lateral tufts of long white or ochraceous hairs (sometimes absent on tergum 6); sternal hairs dark brown, with or without white laterally. Legs of palest specimens pale ochraceous except as follows: scopal hairs pale yellow; basitibial plates pale brown; inner surfaces of basitarsi and fore and hind tibiae dark brown to dark reddish brown; coxae, trochanters and at least proximal part of inner surfaces of femora brown. Darkest with legs similar but with more abundant brown hairs on femora, trochanters and coxae and scopal hairs bright yellow except brown at apex of basitarsi.

*Male.* Measurements and ratios: N, 20; length, 10-15 mm.; width, 3.5-4.5 mm.; wing length,  $M = 3.98 \pm 0.277$  mm.; hooks in hamulus,  $M = 13.25 \pm 0.176$ ; flagellar segment 2/segment 1,  $M = 3.78 \pm 0.085$ .

Structure and color: Integumental color as in *lupina* except eyes usually green to grayish green. Structure as in *composita* except as follows: flagellar segments 5 to 10 with longitudinal, dorsolateral depressions (segment 4 occasionally with depression weakly developed near apex); minimum length of first flagellar segment equals about one-fourth maximum length of second segment; maxillary palpal segments in ratio of about 4:4:3:1, last segment often slightly longer; galeae shiny to moderately so above, dulled by reticular shagreening at least in apical half; sternum 4 with apical margin convex, sterna 3 and 5 with apical margins ex-

tremely weakly convex, almost straight. Sculpturing as in female except as follows: mesoscutum more densely punctate, postero-median area with punctures separated mostly by one to two puncture widths; metasomal tergum 1 with basal two-thirds to three-fourths punctate, punctures separated by one-half (at extreme base) to one puncture width or more; tergum 2 with interband zone with more crowded punctures of irregular size separated mostly by one to two puncture widths; terga 3 and 4 similar to tergum 2 in interband zone but punctures more crowded and smaller; terga 2 to 5 with surfaces of interband zones dulled by distinct reticular shagreening, apical areas highly shiny as in female.

Terminalia essentially as in *lustra* except as follows: sternum 7 with lateral plate with apicomedian margin slightly expanded but not so as to exceed apicolateral process as in *composita*; spatha usually with apicomedian emargination slightly shallower than in either *composita* or *lustra* (Figs. 60-63).

Hair: Vestiture essentially as in *composita* except as follows: generally hair and pubescence more white than in *composita*; pubescent bands of metasomal terga usually white; terga 6 and 7 with hairs dark brown or at least largely so; sternal hairs often brown medially; tergum 5 with distal pubescent band separated from apical margin at least medially.

*Remarks.* Specimens from southern California are generally paler in color and smaller in size than from elsewhere in the range of this species. These differences are not distinct enough nor constant enough to permit the recognition of a separate subspecies. The darkest specimens are most abundant in Colorado and Utah, but appear sporadically from Oregon and California as well.

This species is apparently restricted to plants of the family Compositae for pollen sources. All of the 146 bees bearing floral data (representing 29 collections) were collected from composites (seven genera). Of these 29 collections 20 were made on flowers of *Chrysothamnus* which seems to be of special importance as a pollen source in several parts of the range of the species.

*Type Material.* The holotype female of *glenwoodensis* collected by Gillette at Glenwood Springs, Colorado, August 15, 1903, is in the collection of P. H. Timberlake of the Citrus Experiment Station at Riverside, California.

*Distribution.* *M. glenwoodensis* ranges from southern California north to Washington, east to North Dakota and southeast to Colorado, New Mexico and Utah (Fig. 8). It has been collected from

June 29 to November 4 but mainly during August and September. A total of 73 females and 232 males have been examined, including the holotype, from the localities listed below.

CALIFORNIA: Benton; Big Pine, Inyo Co.; Bridgeport, Mono Co.; Gazelle, Siskiyou Co.; Hallelujah Junction (10 miles N.), Lassen

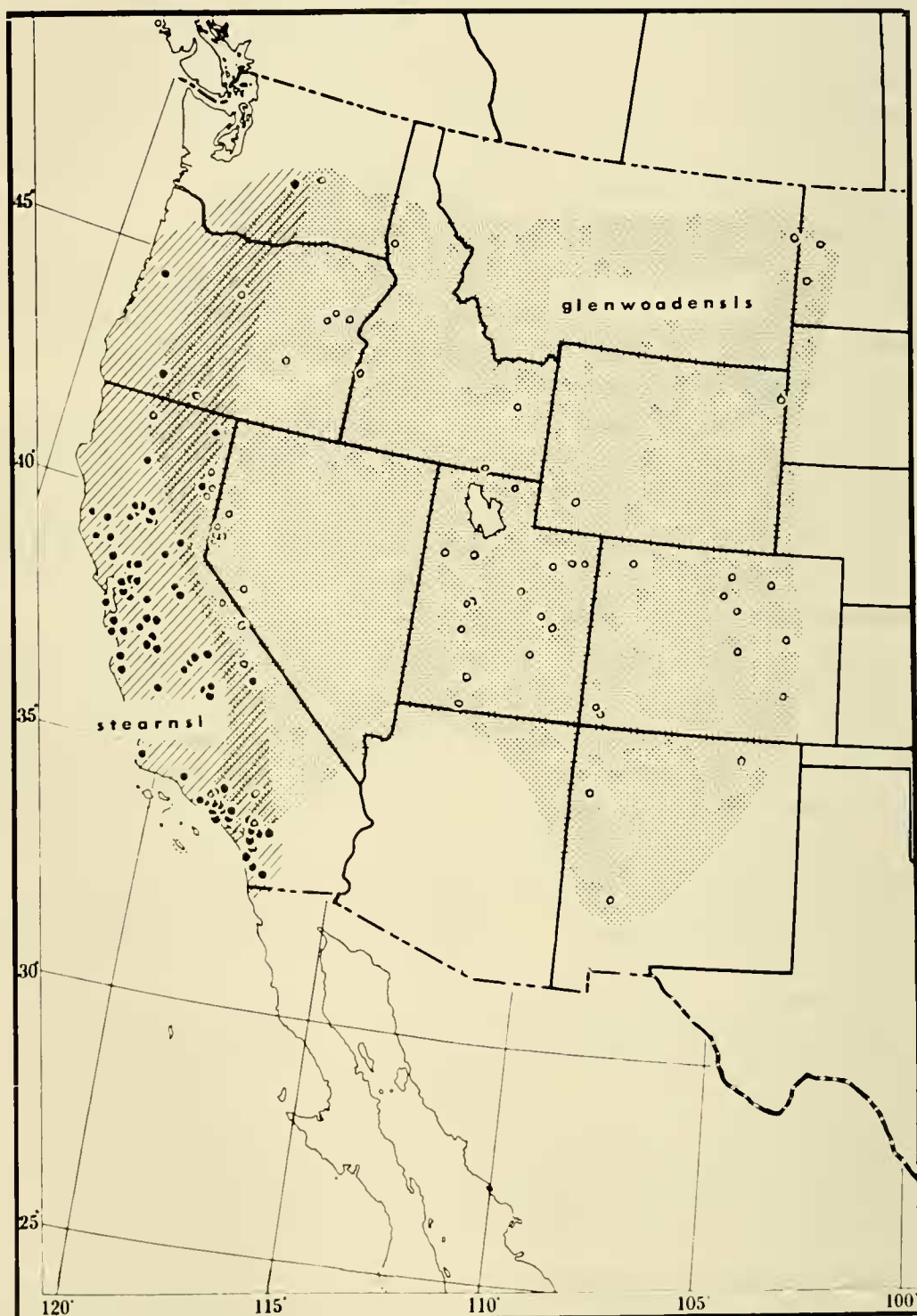


FIG. 8. Map showing the known distributions of *M. (Callimelissodes) stearnsi* Cockerell and *M. (C.) glenwoodensis* Cockerell.



Co.; Helendale; Litchfield; Oro Grande, San Bernardino Co.; Pasadena Quadrangle (Bailey Canyon), San Gabriel Mts.; Ravendale (15 miles S.); Riverside; Sierra Nevadas; Standish (4 miles W.). COLORADO: Colorado Springs; Cortez; Denver; La Junta; Limon; Masonville, Mesa Verde; Moffatt Co.; Platte Canyon; White Rocks (Boulder). IDAHO: Coyote Grade, Nez Perce Co.; Homedale; Idaho Falls; Stone. MONTANA: Fairview. NEVADA: Reno (and 2 miles N. and 14 miles N. E.); Sparks (17 miles N.); Sutcliffe; Walker Lake. NEW MEXICO: Maxwell; McGaffey; Winston. NORTH DAKOTA: Medora (10 miles W.); Schafer. OREGON: Baker (10 miles S.); Burns (23 miles E.); Durkee, Baker Co.; Grizzly Butte; Hereford; Klamath Falls (15 miles E.). UTAH: Allen Canyon; Amalga; Bryce Canyon; Cache Junction; Clear Creek Canyon; Cove Fort; Delta; Deseret; Dugway Parade Ground, Tooele Co.; Emery Co.; Green River; Hanksville; Johnsons Pass, Tooele Co.; Kaibab Forest; Logan Canyon; Roosevelt; Skull Valley (Orr's Ranch); Tridell; Vernal. WASHINGTON: Soap Lake, Grant Co. WYOMING: Clifton, Weston Co.; Granger.

*Flower Records.* *Aster* sp., *Chrysothamnus* sp., *C. nauseosus consimilis*, *C. v. viscidiflorus*, *Cirsium* sp., *Grindelia* sp., *G. squarrosa*, *Helianthus* sp., *H. petiolaris*, *Isocoma vernonioides*, *Solidago* sp., *S. trinervata*.

*Melissodes (Callimelissodes) tuckeri* Cockerell

*Melissodes tuckeri* Cockerell, 1909, Canadian Ent., vol. 41, p. 129.

This species is readily recognized in both sexes by its extremely coarse punctation on all parts of the body. Areas which are normally impunctate or finely punctate in *Melissodes*, such as the genal areas lateral to the eyes, in *M. tuckeri* have crowded, deep, coarse punctures. *M. tuckeri* is not closely related to any of the foregoing species, but judging from the male antennae, the male terminalia and the punctation, it is probably closest to *M. composita*.

*Female.* Measurements and ratios: N, 12; length, 10-12 mm.; width, 3.5-4.0 mm.; wing length,  $M = 3.72 \pm 0.215$  mm.; hooks in hamulus,  $M = 13.83 \pm 0.322$ ; flagellar segment 1/segment 2,  $M = 1.80 \pm 0.025$ .

Structure and color: Integument as in *M. lupina* except eyes green and wing membranes somewhat infumate, yellow to yellowish brown. Clypeus with large punctures separated by less than half a puncture width, surface shiny, unshagreened or slightly so; supraclypeal area with a few large punctures or impunctate me-

dially, surface shiny to somewhat dulled by delicate shagreening; vertex with flattened areas posteromesad of compound eyes with small, crowded, deep punctures separated by less than one puncture width, surface dulled by fine reticular shagreening; genal areas lateral to compound eyes with deep round punctures separated mostly by half a puncture width; face coarsely punctate everywhere except narrow zone just mesad of upper half of compound eye and these zones usually dulled by fine tessellation; ultimate flagellar segment longer than broad; galeae moderately shiny above, dulled by fine reticular shagreening at least in apical half; maxillary palpal segments in ratio of about 3.5:3.5:3.0:1.0. Mesoscutal punctures extremely coarse, separated everywhere by half a puncture width or less, near parapsidal lines separated by one-fourth of a puncture width, surface unshagreened; scutellar punctures similar to mesoscutal but slightly smaller; mesepisternum with punctures of lateral surface extremely large, shallow, almost confluent with only a narrow ridge separating one from another, bottoms of punctures usually finely tessellate; metanotum with punctures almost as large as scutellar; propodeum with dorsal surface reticulopunctate, posterior surface with impunctate upper triangular area and coarsely punctate elsewhere, lateral surfaces coarsely punctate, surfaces dulled by coarse tessellation. Metasomal tergum 1 with basal half or slightly less with small round deep punctures separated by one-half to one puncture width, apical to this punctures become progressively smaller and sparser and apical one-fourth or less impunctate, surface shiny, with extremely fine reticulotransverse shagreening; tergum 2 with interband and basal zones punctate as at base of tergum 1 but punctures slightly smaller, with apical area with conspicuous punctures which are smaller and sparser medially and become smaller and sparser apically, with narrow apical impunctate margin; tergum 3 similar to tergum 2 but apical punctate area restricted to median third and punctures slightly more crowded; tergum 4 as in tergum 3 but without apical area and punctures smaller and more crowded; pygidial plate broadly V-shaped with rounded apex.

Hair: Vestiture as in *composita* with the following differences: pale hairs, especially of vertex and dorsum of thorax, usually darker ochraceous; vertex with more abundant dark brown hairs; mesoscutal dark patch extends forwards to a transverse line at anterior margins of tegulae; tegulae brown; terga 1 to 3 with apical areas with short, suberect to appressed dark brown hairs; tergum 2 with in-

terband zone with suberect to appressed dark brown hairs and white distal and basal bands not or only narrowly connected at sides, with distal pale band interrupted medially by at least width of lateral fascia; tergum 3 with distal band interrupted medially or with rounded posterior median notch which almost interrupts pale band, without white pubescence in interband zone; terga 5 and 6 dark brown to black except long pale lateral tufts; sternal hairs brown to reddish brown medially; legs with dark brown to dark reddish brown hairs on fore tarsi, on fore and middle tibiae near apices of outer surfaces, on inner surfaces of basitarsi and surrounding basitibial plates.

*Male.* Measurements and ratios: N, 8; length, 9-11 mm.; width, 2.5-3.5 mm.; wing length,  $M = 3.37 \pm 0.375$  mm.; hooks in hamulus,  $M = 11.75 \pm 0.250$ ; flagellar segment 2/segment 1,  $M = 4.44 \pm 0.173$ .

Structure and color: Integumental color as in *lupina* but eyes yellowish gray to grayish green and wing membranes somewhat infumate, yellow. Structure as in *plumosa* except as follows: minimum length of first flagellar segment equals about one-fourth of maximum length of second segment; penultimate flagellar segment about twice as long as broad; flagellar segments 3 to 10 with longitudinal, ventrolateral, shiny depressions; maxillary palpal segments in ratio of about 12:9:9:1, last segment often twice as long. Sculpturing as in female except as follows: metasomal tergum 1 with basal four-fifths to five-sixths coarsely punctate with punctures large as scutellar punctures and separated by half a puncture width or less; tergum 2 with punctures of interband and basal zones large, deep, separated by half a puncture width or less, with apical area with distinct punctures in basal half or less; terga 3 and 4 similar to tergum 2 but punctures slightly smaller and more crowded.

Terminalia essentially as in *plumosa* except as follows: sternum 7 with lateral plate with apicomedian margin expanded apically much as in *composita*, with median plate much broader than in *plumosa*; sternum 8 with a few short hairs apically at each side of median emargination; gonostylus with short hairs on outer surface near base and along inner margin.

Hair: Vestiture as in *plumosa* except as follows: vertex often with a few brown hairs; mesoscutum with brown hairs postero-medially; metasomal terga 6 and 7 with abundant dark brown hairs; sternal hairs often yellowish brown to yellow medially.



*Type Material.* Holotype female from Plano, Texas, October 1907, E. S. Tucker, is in the collection of P. H. Timberlake at the Citrus Experiment Station, Riverside, California.

*Distribution.* This species is distributed from Montana south to Texas in the prairies (Fig. 6). It is seemingly a rare species and has been collected infrequently during the months of September and October. A total of 13 females and 8 males, including the holotype, have been examined. The collection data for these is given in full, since so few specimens are involved.

KANSAS: Douglas Co., 1 male on *Aster* sp., October 15, 1949, C. D. Michener; Lawrence, 1 female, September 29, 1954, C. Fitch. MONTANA: Glendive, 1 female, C. N. Ainslie. NEBRASKA: Lincoln, 2 males during September. SOUTH DAKOTA: Cedar Pass (Badlands), 3 males, August 14, 1940, H. E. Milliron; Midland, 1 male, September 10, 1935, A. G. Peterson; Slim Buttes, 2 females, September 7, 1940, H. C. Severin. TEXAS: Brazos Co., 5 females and 1 male on *Aster* sp., October 10, 1954, A. H. Alex, 1 female on *Heterotheca subaxillaris*, October 17, 1955, A. H. Alex; Plano, 2 females, October 1907, E. S. Tucker.

*Melissodes (Callimelissodes) coloradensis* Cresson

*Melissodes coloradensis* Cresson, 1878, Proc. Acad. Nat. Hist. Philadelphia, vol. 30, p. 200; Robertson, 1894, Trans. Acad. Sci. St. Louis, vol. 6, pp. 454-476; 1896, Trans. Acad. Sci. St. Louis, vol. 7, pp. 176-178; 1898, Botanical Gazette, vol. 25, p. 244; 1905, Trans. Amer. Ent. Soc., vol. 21, p. 368; Cockerell, 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 78, 80, 83, 88; Robertson, 1914, Ent. News, vol. 25, p. 70; Cresson, 1916, Mem. Amer. Ent. Soc., vol. 1, p. 115; Robertson, 1926, Ecology, vol. 7, p. 380; 1928, Flowers and Insects, p. 8; Pearson, 1933, Ecol. Monogr., vol. 3, pp. 381, 392, 493; Graenicher, 1935, Ann. Ent. Soc. Amer., vol. 28, p. 304; Brimley, 1938, Insects of North Carolina, p. 462; Bohart, Knowlton and Bailey, 1950, Utah State Agric. Coll. Mimeo. Series No. 371, p. 5.

This large, distinctively colored bee is readily distinguished from the other members of the subgenus *Callimelissodes*. It superficially resembles *Svastra obliqua* (Say), but can be separated from that species by the shape of the tegulae which are narrowed anteriorly as in all species of the genus *Melissodes*. *M. coloradensis* can be separated from other species of the subgenus *Callimelissodes* in both sexes by the deeply infumate wings, the yellow-ochre color of the pale vestiture, the coarsely punctate integument (although less coarse than in *M. tuckeri*) and its large size (equaled only by some specimens of *M. glenwoodensis* in this subgenus). It is most closely related to *M. tuckeri* than to any other members of the subgenus.

*Female.* Measurements and ratios: N, 20; length, 13-16 mm.;

width, 4.5-6.0 mm.; wing length,  $M = 5.25 \pm 0.126$  mm.; hooks in hamulus,  $M = 16.20 \pm 0.304$ ; flagellar segment 1/segment 2,  $M = 1.99 \pm 0.022$ .

Structure and color: Integument black except as follows: distitarsi, apical half of mandible and lower surface of flagellar segments 3 (often apex of 2) to 10 rufescent; wing membranes deeply infumate, brown; eyes dark gray to greenish gray.

Clypeus with small round punctures separated mostly by half a puncture width or less, surface dulled by coarse reticular shagreening; supraclypeal area similar to clypeus but punctures larger medially; vertex with flattened area posteromesad of compound eye with small round punctures separated by half to one puncture width, surface dulled by fine shagreening; eye about 3 times as long as broad; galeae dulled above by fine tessellation; maxillary palpal segments in ratio of about 2.5:3.0:2.0:1.0, last segment variable. Mesoscutum with deep round punctures separated by less than one-half to somewhat more than one puncture width, slightly more crowded anteriorly and laterally than posteromedially, surface shiny, with extremely delicate shagreening or unshagreened; scutellar punctures similar to mesoscutal but average slightly smaller; metanotal punctures half diameter of large scutellar punctures, crowded, mediodorsally separated by about half a puncture width, surface minutely tessellate; propodeum as in *M. lupina* but dorsal surface in apical half with punctures elongate and orientated anterolaterally; mesepisternum with punctures similar in size and spacing to anterior mesoscutal punctures, surface shiny. Metasomal tergum 1 with basal four-fifths punctate, punctures about same diameter as scutellar, smaller towards apical margin, separated by one-half to two puncture widths but mostly by less than one, apical area impunctate, surface dulled by extremely fine, dense, reticulotransverse shagreening; tergum 2 with abundant deep punctures of same size as in tergum 1 or slightly smaller, in basal zone separated by half a puncture width or less, in interband zone separated mostly by one-half to one puncture width, in apical area crowded basally and becoming smaller and sparser apically until apical one-third of apical area impunctate, surface shagreened as in tergum 1; terga 3 and 4 similar to tergum 2 but punctures slightly smaller and more crowded; pygidial plate U-shaped with arms diverging widely towards base.

Hair: Head ochraceous below to yellow-ochre above and vertex with abundant dark brown hairs. Thorax yellow-ochre laterally

to slightly rufescent on anterior part of mesoscutum and pronotum; mesoscutal posteromedian dark brown patch extending laterally to tegulae or almost so and anteriorly to a transverse line at anterior margins of tegulae; tegulae dark brown; scutellum dark brown, narrowly fringed with ochraceous. Metasomal tergum 1 with long yellow-ochre hairs in basal third, apically with minute, simple, appressed, dark brown hairs; tergum 2 with pale ochraceous pubescence at extreme base, with narrow, short, lateral fasciae of ochraceous pubescence distally which equal less than one-third of tergum and in length about half of apubescent area apical to them, not connected with basal pubescence at extreme sides, interband and apical zones with short, closely appressed, simple, dark brown hairs; tergum 3 similar to tergum 2 except basal tomentum dark brown, lateral pale fasciae broader than one-third of width of tergum (occasionally with distal pale band only narrowly interrupted medially) and as long as or longer than apical apubescent area; tergum 4 similar to tergum 3 but distal pale band reaches apical margin except in median one-fourth to one-third, uninterrupted medially; terga 5 and 6 dark brown except pale ochraceous tufts at sides; sternal hairs reddish brown medially to ochraceous laterally. Legs brown except as follows: coxae, trochanters and femora (except at tips) yellow-ochre to ochraceous; inner surfaces of tarsi (including hind basitarsi) red to reddish brown; scopal hairs yellow except brown near apex of basitarsus and near basitibial plate.

*Male.* Measurements and ratios: N, 20; length, 13-16 mm.; width, 4.0-5.5 mm.; wing length,  $M = 4.88 \pm 0.240$  mm.; hooks in hamulus,  $M = 15.05 \pm 0.198$ ; flagellar segment 2/segment 1,  $M = 6.40 \pm 0.103$ .

Structure and color: Integumental color as in female with the following differences: clypeus and base of mandible bright yellow; labrum white; flagellar segments 3 to 11 yellow to red below; wing membranes infumate, yellowish brown, veins dark reddish brown; eyes gray to green.

Structure as in *lupina* except as follows: eyes about two and one-half times as long as broad; maxillary palpal segments in ratio of about 2.5:2.5:2.0:1.0, last segment often slightly shorter; minimum length of first flagellar segment equals less than one-sixth of maximum length of second segment, segments 5 to 10 with longitudinal, ventrolateral depressions (segment 4 occasionally with poorly developed depression); sternum 4 gently convex, without



median emargination; sterna 3 and 5 slightly convex medially or with apical margin transverse. Sculpturing as in female except as follows: metasomal tergum 1 with punctures extending almost to apical margin medially; terga 4 and 5 similar to tergum 3 but apical areas lacking.

Terminalia essentially as in *lupina* except as follows: sternum 7 as in *plumosa* but lateral plate with proximal lateral angle scarcely or not at all indicated, lateral margin from tip of apicolateral process to tip of apodeme forming a relatively smooth sigmoid curve; sternum 8 as in *composita*; length of gonostylus as in *plumosa* and *composita* (shorter than in *lupina*) (Figs. 64-67).

Hair: Vestiture as in female except as follows: tegulae with few brown hairs; mesoscutal dark patch smaller, rounded, about equal in size to scutellar dark patch; metasomal tergum 2 with lateral distal fasciae equal to one-fourth or less of width of tergum and reaching apical margin at extreme sides; tergum 3 with laterodistal fasciae equal to one-third or less of width of tergum; tergum 4 with distal yellow-ochre band narrowly interrupted medially or almost so by apicomedial area of dark brown hairs; tergum 5 as in tergum 4 but distal band uninterrupted; terga 6 and 7 brown medially, ochraceous to rufescent laterally; legs yellow-ochre except inner surfaces of tarsi dark red.

*Remarks.* Notwithstanding its broad east-west distribution (North Carolina to California), *M. coloradensis* is relatively uniform in color throughout its range. Considering again its broad range, it is somewhat surprising that *coloradensis*, a large and conspicuous bee, has been collected so sparingly.

This species is dependent upon plants of the family Compositae and, in particular, upon the genus *Helianthus* for pollen sources. In the vicinity of Lawrence, Kansas, the author was able to take *coloradensis* females gathering pollen only on *Helianthus*, although males and females were both found visiting *Vernonia* and a few other plants for nectar. Furthermore, *M. coloradensis* has been collected throughout most of its range visiting *Helianthus*. Robertson (1926) states that *coloradensis* is an oligolege of composites of the tribes Heliantheae and Cynarieae. However, if one examines records published by Robertson (1928), one finds that there are no known records of females collecting pollen on plants of the tribe Cynarieae. The few records of *coloradensis* taken on plants of the tribe Cynarieae given by Robertson (1928, pp. 65-67) involve a few specimens sucking nectar from flowers of *Cirsium* spp. There-

fore, it appears that *coloradensis* should be considered as an oligolege of the tribe Heliantheae alone, and perhaps of the genus *Helianthus*.

*Type Material.* Lectotype female and allotype male from Colorado are in the collection of the Academy of Natural Sciences of Philadelphia. Three female and two male paratypes from Colorado are with the lectotype.

*Distribution.* This species is distributed from North Carolina to California and from Wisconsin in the north to Arizona in the south (Fig. 4). It has been collected between the dates of July 2 and October 13. A total of 43 females and 37 males have been examined (including the type material) from the localities listed below. This list includes records reported in the literature.

ARIZONA: Flagstaff; Fredonia. CALIFORNIA: Canby, Modoc Co. ILLINOIS: Ashburn; Carlinville; Chicago (in vicinity of); Macoupin Co.; Peoria (at airport). INDIANA: 1 female labeled "Ind. Aug." KANSAS: Baldwin; Baldwin Junction, Douglas Co.; De Soto, Douglas Co.; Garnett; Lawrence; Lone Star Lake, Douglas Co.; Olathe; Riley Co. MISSOURI: Columbia (12 miles E.); Ozark Lake. NEBRASKA: Fairmont; Lincoln; Malcolm; Nebraska City; Omaha. NEW MEXICO: Bernalillo. NORTH CAROLINA: Cary; Raleigh. OHIO: Bowling Green (4 miles W.). UTAH: Allen's Canyon; Cornish; Greenriver; Ogden; Snowville. WISCONSIN: Milwaukee. WYOMING: Green River.

*Flower Records.* *Cirsium* sp., *C. discolor*, *C. lanceolatum*, *Coreopsis* sp., *C. tripteris*, *Helianthus* sp., *H. annuus*, *H. atrorubens*, *H. divaricatus*, *H. grosse-serratus*, *H. mollis*, *H. petiolaris*, *H. scaberrimus*, *H. tuberosus*, *Heliopsis helianthoides*, *H. laevis*, *Liatris pycnostachya*, *Lythrum alatum*, *Rudbeckia laciniata*, *Silphium* sp., *S. integrifolium*, *S. laciniatum*, *S. perfoliatum*, *S. terebinthinaceum*, *Solanum* sp., *Solidago serotina*, *Verbena hasta*, *V. stricta*, *Vernonia* sp., *V. baldwini interior*, *V. fasciculata*.

### *Melissodes (Callimelissodes) stearnsi* Cockerell

*Melissodes stearnsi* Cockerell, 1905, Bull. S. California Acad. Sci., vol. 4, p. 101; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 90; Linsley, 1946, Jour. Econ. Ent., vol. 39, p. 20.

*Exomalopsis stearnsi* Cockerell, 1906, Pomona Jour. Ent. Zool., vol. 8, p. 59; Lutz & Cockerell, 1920, Bull. Amer. Mus. N. Hist., vol. 42, pp. 567, 612.

This small distinctive bee is not closely related to any of the other members of the subgenus. The female is readily recognized by the diffuse pale pubescence on the abdominal terga and by the

abundant, long, hooked galeal hairs. The male is readily recognized by the cream-colored clypeus, the extended, hyaline, almost colorless, apical margins of sterna 3 to 5 and by the terminalia as described below.

*Female.* Measurements and ratios: N, 20; length, 8-11 mm.; width, 2.5-4.0 mm.; wing length,  $M = 2.95 \pm 0.139$  mm.; hooks in hamulus,  $M = 11.05 \pm 0.160$ ; flagellar segment 1/segment 2,  $M = 1.58 \pm 0.019$ .

Structure and color: Integument as in *lupina* except as follows: clypeus often red anteromedially; metasomal terga 1-4 often dark reddish brown apically. Structure as in *lupina* except last flagellar segment longer than broad, maxillary palpal ratio about 4:3:2:1 and galeae with abundant long hooked hairs. Sculpturing as in *lupina* except as follows: clypeus with punctures large, in apical half or more elongated, in posteromedian area separated by one to two puncture widths, surface tessellate especially posteriorly; supra-clypeal area impunctate medially, tessellate; vertex with flattened area posteromesad of compound eye with irregular-sized punctures separated mostly by one puncture width or more, surface unshagreened or slightly so; galeae dulled above by regular tessellation; mesoscutum with large posteromesad area impunctate, shiny, anterior third and laterally with large punctures separated by half a puncture width or less, surface shiny; scutellum with small round punctures separated by one-half to one puncture width, unshagreened; mesepisternal punctures round, deep, almost confluent, separated by one-third puncture width or less, surface dulled by dense shagreening; metasomal tergum 1 with basal half or slightly more punctate, punctures crowded basally to sparse apically, apical area impunctate, surface reticulotransversely shagreened; tergum 2 with basal area punctures separated by one-half to one puncture width, surface shiny, interband zone with punctures irregular, separated by one to two puncture widths, reticulotransversely shagreened, apical area (beneath pale pubescence) with shallow punctures separated by one-half to one puncture width, surface as in interband zone; terga 3 and 4 similar to tergum 2 but interband zone punctures distinctly smaller and more crowded.

Hair: Head pale ochraceous, yellowish on vertex. Thorax pale ochraceous laterally to yellowish on dorsum, scutellum with sparse brown hairs medially, mesoscutum with posteromedial area bare but a few brown hairs occasionally present on periphery of bare area. Metasomal tergum 1 with long pale ochraceous hairs basally



and to apical margin at extreme sides, bare apically; tergum 2 with dense white pubescence at extreme base, apical area with diffuse, appressed, short, white to subochraceous pubescence (often worn away in mediobasal part of apical area), interband zone with scattered pale pubescence and suberect pale hairs; terga 3 and 4 similar to tergum 2 but tomentum at extreme bases pale brown and interband zones with more abundant diffuse pale pubescence; terga 5 and 6 dark ochraceous medially and with white tufts at extreme sides; sternal hairs reddish brown to yellow medially, apically and laterally white. Legs pale ochraceous to white except as follows: fore tarsi, inner surfaces fore tibiae, inner surfaces middle and hind tarsi dark brown to reddish brown; scopal hairs white except brown near basitibial plates, highly plumose.

*Male.* Measurements and ratios: N, 20; length, 8-11 mm.; width, 2.5-3.5 mm.; wing length,  $M = 2.95 \pm 0.124$  mm.; hooks in hamulus,  $M = 10.45 \pm 0.209$ ; flagellar segment 2/segment 1,  $M = 6.61 \pm 0.138$ .

Structure and color: Integumental color as in *lupina* except as follows: clypeus and base of mandible cream-colored or pale yellow; metasomal terga 1-5 with apical areas subhyaline or translucent, brown. Structure as in *lupina* except as follows: eyes half as broad as long or almost so; minimum length of first flagellar segment less than one-sixth maximum length of second segment, dorsolateral depressions on segments 5 to 9 and usually extremely shallow or scarcely discernible, ultimate segment less than thrice and more than twice as long as broad, penultimate segment twice as long as broad or shorter; maxillary palpal ratio about 4.0:3.5:3.0:1.0; galeae above with abundant, extremely short, straight hairs, apical margin of sternum 4 produced into a broad, hyaline, colorless, medially emarginate flap equal in medial length to basal part of sternum or more; sterna 2 and 3 similarly produced but less so; sternum 5 with convex apical margin. Sculpturing as in female except as follows: galeae above often less intensely tessellate especially in basal third; mesoscutal posteromedial area reduced to about half of scutellum in size and occasionally with a few punctures scattered throughout; metasomal tergum 1 with punctures in basal four-fifths; terga 2 to 4 with interband zone punctures coarser than in female and apical area punctures less abundant.

Sternum 7 with median plate large, more than twice lateral plate in area (excluding neck region of median plate), apical margin forming a sigmoid curve with inner curve larger, apicolateral angle

usually folded somewhat over neck region; membranous area short and broad. Sternum 8 as in *lupina* except apex narrower and with abundant hairs at apical margin in and on each side of median emargination. Genital capsule much as in *lupina* except as follows: gonostylus short (equals half or less of gonocoxite laterally), not capitate; gonocoxite with sparse, minute spicules apically, ending in a narrow blunt process apicodorsally; spatha with apical margin scalloped, usually not emarginate medially (Figs. 68-71).

Hair: Head and thorax pale ochraceous to white. Metasomal vestiture as in female except as follows: tergum 1 with pale hairs almost to apical margin medially; terga 2-4 with diffuse pubescence of apical area usually not reaching apical margin medially (usually worn here) so that distinct bands usually present, with interband zones with less diffuse pubescence and more suberect to erect pale hairs; tergum 5 similar to tergum 4 but apical pubescence reaching medially (rarely worn away); terga 6 and 7 as in terga 5 and 6 of female; sternal hairs ochraceous to yellowish and extremely short medially to long and white or pale ochraceous laterally. Legs white to pale ochraceous except inner surfaces tarsi yellow.

*Remarks.* The hooked galeal hairs of the female of *M. stearnsi* are of special interest. Certain other bees, such as *Proteriades* (Michener, 1944, p. 218) and *Melissodes* (*Apomelissodes*) *apicata* (LaBerge, 1956, pp. 554-555), which have such hooked galeal hairs are seemingly oligoleges of plants whose flowers are small and tubular. The hooked hairs are an adaptation for removing pollen from these small tubular flowers.

In the case of *stearnsi* this is not so clear. This species does not appear to be highly oligolectic, although it has been collected much more frequently from various composites than from any other family of plants (see Table III). In this respect it conforms with most other species of the subgenus *Callimelissodes*. Almost half of the bees and slightly more than half of the collections of *stearnsi* in which floral data is present are from composites. However, among the 10 genera of composites recorded as being visited by this bee, no one genus is clearly preferred. Linsley (1946, p. 26) states that *stearnsi* was observed collecting pollen in several alfalfa fields in the Tracy-Patterson area of California, but was present in significant numbers in only one of these fields. Unfortunately, Linsley did not have the opportunity to study the habits of *stearnsi* nor to evaluate the importance of this species as a pollinator of alfalfa.

TABLE III. Summary of Floral Records for *Melissodes stearnsi*.

Plant Data			Floral data of <i>M. stearnsi</i>			
FAMILY	Number of genera	Number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae	10	14	33	44	38	82
Polemoniaceae	2	2	5	8	0	8
Asclepiadaceae	1	2	6	8	196	204
Leguminosae	1	1	6	2	6	8
Labiatae	1	1	4	4	2	6
Others (5)	6	6	9	5	11	16
Totals	21	26	63	71	248	319

The small size of the bee as well as the hooked galeal hairs make *stearnsi* admirably adapted for collecting pollen from the small tubular flowers of the Polemoniaceae. Females of *stearnsi* have been collected a number of times from two genera (*Hugelia* and *Gilia*) of this family. The Polemoniaceae are, generally speaking, poor collecting for an entomologist interested in bees. For these reasons, it is tempting to predict that *stearnsi* will be found to be an oligolege on plants of the family Polemoniaceae and that the present collections do not support this hypothesis because the phloxes are not as assiduously searched for bees by entomologists as are other plants, such as the composites.

Another hypothesis which could lead to interesting evolutionary speculation is that *M. stearnsi* evolved as an oligolege of such plants as the Polemoniaceae, but has subsequently become more diversified in its pollen-source preferences. Additional collections with serious study of the habits of this bee in nature are needed to resolve these questions.

*Type Material.* Holotype female of *stearnsi* from Los Angeles, California, collected by Davidson is in the collection of P. H. Timberlake at the Citrus Experiment Station, Riverside, California.

*Distribution.* This species is distributed from southern California to Washington and is, by far, most abundant in California (Fig. 8).



It has been taken between the dates of March 4 and October 12 but mainly during the months of June to August. A total of 264 females and 431 males, including the holotype, have been examined from the localities listed below (including records from the literature).

CALIFORNIA: Alpine; Antioch; Arroyo Seco, Monterey Co.; Artois; Auburn; Bass Lake, Modoc Co.; Calistoga; Chico; Claremont; Clear Lake; Clovis (4 miles N.); Coalinga (7 miles N. W.); Covina; Davis; Dos Palos; Dutch Flats, Placer Co.; Elsinore; Fresno; Friant; Galt; Glen Ivy; Hamilton City; Hemet; Hopland Field Station, Mendocino Co.; Jamesburg (Hastings Natural History Reservation); Knoxville; Lindsay; Los Angeles; Los Angeles Co.; Los Banos; Masourka Canyon, Inyo Mts.; Mendocino Co.; Mix Canyon, Solano Co.; Mokelumna Hill; Mt. Diablo, Contra Costa Co.; Mt. Santiago; Murphys; Murrieta; Nelson; Ojai (7.8 miles W.); Orland; Oroville; Palmdale (Mohave Desert); Palo Alto; Pasadena; Patterson; Pillsbury Lake, Lake Co.; Poway; Puente; Puente Hills; Putah Canyon, Solano Co.; Rawhide; Redding; Riverside; Romoland; Ryer Island, Solano Co.; San Dimas; San Gabriel Mts. (near Pasadena); Santa Clara Co.; Santa Cruz Co.; Spreckels; Stockton; Sunset Valley, Santa Barbara Co.; Temecula; Tollhouse; Topanga Canyon; Tracy; Tuckers Grove; Turlock; Visalia; Vista; Watts Valley; Westley; Westwood Hills, Los Angeles Co.; Whittier; Willows; Winters; Woodlake; Yorba Linda. OREGON: Butte Falls (7 miles W.); Lane-Benton Park (20 miles S. of Corvallis); Medford. WASHINGTON: Colokum Pass.

*Flower Records.* *Althaea rosea*, *Asclepias* sp., *A. eriocarpa*, *Aster* sp., *A. exilis*, *Brassica* sp., *Centaurea solstitialis*, *Centromadia* sp., *C. pungens*, *Cirsium* sp., *Cleome* sp., *Corethrogyne* sp., *C. bernardense*, *C. virgata*, *Datura* sp., *D. metaloides*, *Eremocarpus setiger*, *Ericameria palmeri*, *E. parishii*, *Eriogonum* sp., *E. setiger*, *Gilia virgata*, *Gutierrezia* sp., *G. californica*, *G. sarothrae*, *Helianthus* sp., *H. annuus*, *Heliotropium curassavicum*, *Hemizonia* sp., *H. fasciculata*, *Hugelia virgata*, *Medicago sativa*, *Silybum marianum*, *Trichostema* sp., *T. lanceolatum*.

#### Subgenus *Eumelissodes* LaBerge

*Eumelissodes* LaBerge, 1956, Univ. of Kansas Sci. Bull., vol. 37, p. 1177. Type species: *Melissodes agilis* Cresson, by original designation.

This subgenus has been described in detail by LaBerge (1956, p. 1177). A brief diagnosis is given here with a few additional characteristics added.

*Female.* Clypeus flat to gently protuberant, never protruding beyond eye in profile by as much as half width of eye; galeae smooth and shiny to variously shagreened or tessellate, less than twice and usually less than one and one-half times as long as median clypeal length; maxillary palpi 4-segmented; last flagellar segment always longer than broad, second flagellar segment usually slightly broader than long, but occasionally as long as broad or slightly longer. Metanotum usually shorter than dorsal surface of propodeum medially, rarely longer; propodeum with dorsal surface rarely punctate apically and then punctures small and obscured by tessellation, reticulorugose basally. Metasomal tergum 7 with gradulus with lateral parts absent or cariniform and short, never lamelliform or long.

Vestiture variable; thorax and tergum 2 without spatuloplumose hairs; terga 2-4 never with apical pale bands subequal to each other in length and subequal in length across each tergum, that of tergum 2 usually narrowly interrupted medially; scopal hairs usually highly plumose, never simple.

*Male.* Clypeus entirely pale to entirely black in color; labrum often all dark-colored, usually with mediobasal pale spot, rarely entirely pale but often mostly pale except for narrow brown apical margin; mandibles often with basal yellow spots. Minimum length first flagellar segment always less than half maximum length second segment and usually less than one-third second segment. Sterna 3-5 with apical margins slightly but distinctly concave or straight, never broadly convex or produced into a bilobed flap. Gonostylus usually somewhat capitate, often not, half as long as gonocoxite or longer in dorsal view, slender, usually less than half as wide as greatest width of penis valve, with short hairs near base and often on outer surfaces; sternum 7 with median plate large, flat, transparent, with abundant hairs ventrally; lateral plate usually piceous at least apically, with distinct apical or apicolateral process, greater than one-third median plate in area. Other structural characters as in female.

Vestiture as in female but tergum 5 often with pale band similar to that of tergum 4; terga 6 and 7 often with pale hairs.

KEY TO THE SPECIES OF THE SUBGENUS EUMELISSODES

MALES

1. Metasomal terga usually with no complete pale pubescent bands, *if* at most one complete band present (tergum 2), *then* labrum all or almost all black and thorax with ferrugineous to rufous hairs..... *dentiventris* Smith  
Metasomal terga 2-5 usually all with pale distal band, *if* only one complete band present, *then* not on tergum 2 or labrum with large yellow spot and/or thoracic hairs not ferrugineous, often partly brown..... 2
- 2 (1). Labrum wholly light-colored (without narrow brown apical margin); mandible with a large basal pale spot,  
*verbesinarum* Cockerell (in part)  
Labrum usually at least margined with dark and mandible often without light basal spot..... 3
- 3 (2). Penultimate flagellar segment less than three times as long as wide (narrowest width and maximum length); flagellum in repose not surpassing pterostigma..... 4  
Penultimate flagellar segment three times as long as broad or longer and/or antennae in repose surpassing pterostigma.. 10
- 4 (3). Labrum and bases of mandibles black; propodeum with dorsal surface with small, round, discrete punctures laterally of about same size as on scutellum; metasomal tergum 1 with short, appressed, simple brown hairs apically,  
*paucipuncta*, n. sp.  
Labrum and bases of mandibles black or with yellow spots; propodeum with dorsal surface reticulorugose, at least basally, punctures when present elongate; metasomal tergum 1 with long erect or suberect hairs reaching or almost reaching margin ..... 5
- 5 (4). Penultimate flagellar segment twice as long as wide or shorter; maximum length first flagellar segment about half as long as maximum length second segment,  
*monoensis*, n. sp.  
Penultimate flagellar segment longer than twice width; maximum length first flagellar segment less than half as long as second ..... 6
- 6 (5). Labrum and bases of mandibles black, without yellow spots; antennae in repose reaching pterostigma..... 7  
Labrum and often mandibles marked with yellow; antennae in repose often not reaching pterostigma..... 8
- 7 (6). Metasomal terga 2 and 3 with interband zones with surfaces dulled by fine, dense, reticulotransverse shagreening; minimum length first flagellar segment usually equals one-third or more maximum length second segment,  
*grindeliae* Cockerell (in part)  
Metasomal terga 2 and 3 with interband zones with surfaces shiny, unshagreened, minimum length first flagellar segment equals less than one-third maximum length second segment ..... *hymenoxidis* Cockerell



- 8 (6). Mandibles with basal yellow maculae,  
*pallidesignata* Cockerell (in part)  
 Mandibles without basal yellow maculae..... 9
- 9 (8). Terga 2-5 with apical areas opaque, deep reddish brown;  
 terga 4-6 with basal areas covered with reddish brown  
 hairs and pubescence.....*rustica* (Say) (in part)  
 Terga 2-5 with apical areas hyaline, colorless to testaceous  
 or yellowish brown; terga 4-6 with basal areas with pale  
 pubescence and hairs.....*pallidesignata* Cockerell (in part)
- 10 (3). Mesoscutal and scutellar punctures minute, mesoscutum with  
 large posteromedian area impunctate or with scattered  
 punctures less than  $\frac{1}{3}$  mesepisternal punctures in diameter,  
 mesoscutal punctures anteromedial to parapsidal lines no  
 larger and usually smaller than mesepisternal punctures  
 and separated mostly by 2 to 3 puncture widths or more,  
*expolita*, n. sp.  
 Mesoscutal and scutellar punctures larger and more abundant,  
 posteromedial mesoscutal area with scattered punctures as  
 large as or larger than mesepisternal punctures, area antero-  
 medial to parapsidal lines with punctures at least as large  
 as mesepisternal punctures and usually separated by one  
 puncture width or less..... 11
- 11(10). Metasomal terga with apical areas deeply infumate, com-  
 pletely opaque or almost so; clypeus yellow except apical  
 margin and spots or notches at anterior tentorial pits..... 12
- Metasomal terga with apical areas transparent, colorless or  
 slightly infumate and translucent, not opaque; *if* infumate  
 and opaque or almost so, *then* with clypeus black or par-  
 tially black ..... 30
- 12(11). Minimum length first flagellar segment equals  $\frac{1}{4}$  or less of  
 maximum length second segment and usually no longer  
 than pedicel on the same side; terga 2 and 3 often with  
 distinct punctures in apical areas ..... 13
- Minimum length first flagellar segment equals more than  $\frac{1}{4}$  of  
 maximum length of second segment, distinctly longer than  
 pedicel on same side; terga 2 and 3 usually with apical  
 areas impunctate ..... 27
- 13(12). Clypeus white or creamy anteriorly with black extending  
 down from face onto posterior part; without pale spots on  
 bases of mandibles; galeae densely tessellate,  
*denticulata* Smith (in part)  
 Clypeus all pale except spots or notches at tentorial pits and  
 anterior margin, or *if* black extends down from face onto  
 posterior part of clypeus, *then* pale portion bright yellow,  
 not whitish; mandibles often with pale basal spots; galeae  
 variable, may be tessellate ..... 14
- 14(13). Basitibial plate with apical margin straight and at right angles  
 to posterior margin; apical area of tergum 2 with small  
 piliferous punctures; minimum length first flagellar seg-  
 ment usually  $\frac{1}{10}$  maximum length second segment or less,  
*manipularis* Smith

- Basitibial plate rounded apically, *if* somewhat truncate, *then* apical area tergum 2 without piliferous punctures; shortest length first flagellar segment usually slightly longer than  $\frac{1}{10}$  of longest length second segment ..... 15
- 15(14). Clypeus all pale except spots or notches at tentorial pits and anterior margin, *if* narrowly infuscated posteriorly, *then* hairs on mesonotum anterior to patch of dark hairs white to pale ochraceous, *or* mesoscutum without dark hairs; mandibles often with pale basal spots ..... 16
- Clypeus not all pale, infuscated posteriorly at least; hairs on mesoscutum anterior to dark patch fulvous or ferrugineous; mandibles without yellow basal spots ..... 25
- 16(15). Clypeus white or cream-colored, about same color as pale spot on labrum; spots at base of mandibles white; with piliferous punctures in marginal areas terga 2 and 3, *pilleata*, n. sp.
- Clypeus yellow, usually more brightly colored than pale labral spot if the latter is present; basal mandibular spots yellow, if present; *if* the above areas cream-colored, *then* without piliferous punctures in apical areas terga 2 and 3 ..... 17
- 17(16). Hairs of thorax pale to bright ferrugineous, without dark hairs on mesoscutum or scutellum; metasomal tergum 3 with apical area with few or no piliferous punctures although dark brown hairs may be present.....*trinodis* Robertson
- Thorax with hairs ochraceous to white *and/or* large dark mesoscutal patch present; *if* dark hairs absent on mesoscutum and scutellum, *then* apical area tergum 3 with minute piliferous punctures ..... 18
- 18(17). Posterior surfaces hind basitarsi with hairs as long as tibial spurs and tibiae with hairs as long as tibial spurs or almost so; sterna with interpunctural surface shiny, unshagreened ..... *interrupta*, n. sp.
- Posterior surfaces hind basitarsi with hairs much shorter than tibial spurs; sterna often with interpunctural surfaces dulled by reticular shagreening; tibial hairs shorter than tibial spurs ..... 19
- 19(18). Thorax with hairs posterior to dark brown patch ferrugineous; first metasomal tergum with small punctures separated by much more than one puncture width and usually 2 or 3, with apical area with dark brown or black hairs in narrow band medially and widening into two lateral lobes extending back more than one-half width of dorsum of tergum at sides; terga 2 and 3 with abundant brown hairs apically, but these not arising from distinct punctures ..... 20
- Thorax with hairs posterior to dark brown patch pale, not ferrugineous; first metasomal tergum with punctures more closely spaced, with apical area without dark brown hairs or these not arranged in narrow band medially and two lateral lobes; terga 2 and 3 without dark hairs apically or these arise from distinct punctures; or not with all of these characters combined..... 21

- 20(19). Terga 2-4 with interband zones impunctate or almost so, dulled by fine, dense tessellation; labrum and usually bases of mandibles with pale spots. . . . . *wheeleri* Cockerell  
 Terga 2-4 with abundant round punctures in interband zones, surface with weak tessellation; labrum and bases of mandibles without pale spots, black. . . . . *pullata* Cresson
- 21(19). Mesoscutum and scutellum with abundant dark brown or black hairs; mesepisterna usually roughened by coarse shagreening; terga 2 and 3 with apical areas impunctate or indistinctly so. . . . . 22  
 Mesoscutum and usually scutellum without dark hairs (occasionally present on both); mesepisterna with surface usually smooth and shiny, lightly shagreened if at all; terga 2 and 3 with apical areas with piliferous punctures. . . . . 23
- 22(21). Minimum length first flagellar segment usually equals  $\frac{1}{8}$  to  $\frac{1}{9}$  maximum length second segment; galeae usually shiny above, lightly shagreened or not at all except near tips, *illata* Lovell and Cockerell  
 Minimum length first flagellar segment  $\frac{1}{7}$  or more of maximum length of second segment, never as little as  $\frac{1}{8}$ ; galeae above usually shagreened at least in apical half, rarely shiny and unshagreened. . . . . *subillata*, n. sp. (in part)
- 23(21). First metasomal tergum with long, white or pale ochraceous, barbed, subappressed hairs in apical area. . . . . *elegans*, n. sp.  
 First metasomal tergum medially with short, relatively simple, appressed, brown to black hairs in apical  $\frac{1}{4}$  or more. . . . . 24
- 24(23). First metasomal tergum more coarsely punctate; terga with apical areas dark brown, only slightly translucent; mesepisterna coarsely punctate. . . . . *boltoniae* Robertson  
 First metasomal tergum less coarsely punctate; terga usually with apical areas pale brown and translucent to transparent; mesepisterna less coarsely punctate. . . . . *fumosa*, n. sp.
- 25(15). Clypeus flat, with deep, round punctures as large as those on supraclypeal area. . . . . *elegans*, n. sp. (in part)  
 Clypeus strongly bowed out, with small, indistinct punctures obscured by dense shagreening. . . . . 26
- 26(25). Mesoscutum and scutellum and usually tegulae with dark brown hairs; clypeus usually half black or more, *tincta*, n. sp.  
 Mesoscutum and scutellum with few or no dark hairs, no dark hairs on tegulae; clypeus with very narrow posterior margin infuscated, if at all. . . . . *trinodis* Robertson (in part)
- 27(12). Terga 2 and 3 with apical areas (just apical to pale pubescent band) with large, distinct punctures, 3 or 4 times as broad as bases of hairs arising from them; terga 3 and 4 with interband zones opaque, dulled by small, dense tessellation; galeae shiny above, unshagreened except near tips; mesoscutal hairs long, pale. . . . . *fasciatella*, n. sp.  
 Terga 2 and 3 with apical area without distinct punctures or



- these minute; terga 3 and 4 with interband zones shiny or moderately shiny, *if* finely tessellate and opaque, *then* galeae dulled above by dense shagreening in at least apical half ..... 28
- 28(27). Hairs of mesoscutum and scutellum ferrugineous, no dark brown or black hairs; tergum 5 with pubescence brown at least medially ..... *bidentis* Cockerell
- At least scutellum with some dark brown or black hairs and often mesoscutum as well, *if* without dark hairs, *then* mesoscutal hairs pale ochraceous or cinereous; pubescence of tergum 5 usually pale ..... 29
- 29(28). Terga 2-4 with apical areas no wider than or very slightly wider than pale distal bands on those segments; terga 2-5 with apical areas shiny, only delicately shagreened, often with a few piliferous punctures basally and laterally, usually reddish brown in color ..... *rustica* (Say) (in part)
- Terga 2-4 with apical areas as wide or wider than width of pale distal band on those segments; terga 2-5 with apical areas usually black, opaque, dulled by dense reticular shagreening, with no piliferous punctures but often with short, simple, appressed, dark brown hairs *subillata*, n. sp. (in part)
- 30(11). Hind legs with hairs short, tibiae with mid-outer surfaces with hairs mostly  $\frac{2}{3}$  as long as maximum width of tibiae or less; galeae dulled above by dense, regular tessellations; pale areas of clypeus white or cream-colored ..... 31
- Hind legs with longer hairs, tibial mid-outer surface with hairs mostly longer than  $\frac{2}{3}$  maximum width of tibiae; galeae variously sculptured; pale areas of clypeus usually yellow, 32
- 31(30). Terga 2 and 3 with interband zones with distinct punctures, especially laterally and beneath distal pale band, surfaces relatively shiny, reticular shagreening present but not so dense as to make surface opaque; clypeus darkened posteriorly; mandible without pale basal spot; terga 2-5 with apical areas usually piceous or at least infumate, *denticulata* Smith (in part)
- Terga 2 and 3 with interband zones with few or no punctures, when present punctures small, shallow, indistinct, surfaces dulled by dense reticular shagreening; clypeus usually entirely pale; base of mandible usually with pale spot; terga 2-5 usually with apical margins hyaline, colorless to slightly yellowed ..... *veroniae* Robertson
- 32(30). Maximum length first flagellar segment equal to more than  $\frac{1}{3}$  minimum length *third* flagellar segment ..... 33
- Maximum length first flagellar segment equals  $\frac{1}{3}$  or less minimum length *third* flagellar segment ..... 39
- 33(32). Wing veins yellow to red; galeae shiny, unshagreened above; terga 2-5 with interband zones impunctate or with punctures minute (scarcely wider than bases of hairs arising from them) and obscured by dense shagreening; mandible

- without yellow spot at base; labrum with or without pale median spot ..... *perlusa* Cockerell (in part)
- Wing veins brown or reddish brown, *or, if yellow, then either* terga 2-5 with distinct punctures in interband zones, *or* mandible with basal yellow spot, *or* galeae dulled by shagreening above ..... 34
- 34(33). First metasomal tergum with distinct distal band of long, dense, appressed or subappressed, white hairs reaching apical margin and obscuring apical hyaline zone across entire tergum (occasionally worn) ..... 35
- First metasomal tergum without apical band of dense white hairs or these restricted to lateral patches each  $\frac{1}{2}$  width of tergum or less, *or, if present across tergum, then not obscuring surface medially* ..... 37
- 35(34). Base of mandible with yellow spot; labrum yellow with dark border; minimum length first flagellar segment usually equals  $\frac{1}{2}$  or more maximum length *third* segment ..... 36
- Base of mandible black; labrum black or with small medio-basal pale spot; minimum length first flagellar segment usually equals less than  $\frac{1}{2}$  maximum length third segment, *bimatrix*, n. sp.
- 36(35). Mesoseutum with posteromedian area punctures separated mostly by more than one puncture width, *semilupina* Cockerell
- Mesoscutum with punctures of posteromedian area separated mostly by less than one puncture width ..... *ochraea*, n. sp.
- 37(34). Mandible usually without basal pale spot, *if* pale spot present, *then* mesoscutum and scutellum with black hairs medially; galeae with surfaces dulled by dense shagreening, *robustior* Cockerell
- Mandible with basal yellow spot and mesoseutum without black or dark brown hairs, *or* galeae with surface shiny, not dulled by shagreening ..... 38
- 38(37). Labrum and mandibular bases with yellow; mesoseutum and scutellum without dark hairs medially, *menuachus* Cresson (in part)
- Labrum and mandibular bases without pale spots; mesoscutum and scutellum often with abundant dark hairs medially ..... *grindeliae* Cockerell (in part)
- 39(32). Clypeus all or partially black ..... 40
- Clypeus all light-colored except anterior margin and notches or spots at tentorial pits ..... 54
- 40(39). Clypeus usually partly yellow; flagellar segments with flattened or depressed area laterodorsally, this area shiny; galeae shiny above, unshagreened except at tips; terga with apical areas opaque, dark reddish brown to black, *paulula*, n. sp.
- Clypeus partly or wholly black; flagellar segments not depressed or flattened laterodorsally, *or, if so, then* flattened areas not shiny; galeae variable, often shagreened or tessellate above; terga various, but often hyaline apically. . . . 41

- 41(40). Clypeus entirely black; without black or dark brown suberect hairs on terga 2-7; clypeus often with small median shiny boss; antennae extremely long, usually last segment or two darker than preceding segments; body vestiture generally white ..... *tristis* Cockerell (in part)  
Clypeus usually with some yellow or whitish marking, *if* entirely black, *then either* terga with some dark brown or black, erect or suberect hairs (especially in apical areas of terga 2 and 3 or in interband zones of terga 3-5), *or* body vestiture yellowish and last segments of antennae not darker than preceding segments ..... 42
- 42(41). Clypeus entirely black; galeae dulled by fine dense tessellation, with at least longer hairs on basal half hooked or bent near tips; last 5 or 6 flagellar segments nodose,  
*melanura* Cockerell  
Clypeus not entirely black, or *if* all black, *then* galeae shiny or only slightly shagreened, not tessellate and without hooked hairs; flagellar segments usually not nodose ..... 43
- 43(42). With black or brown hairs on vertex between the eyes.... 44  
Without black or brown hairs on vertex of head..... 50
- 44(43). Last two flagellar segments entirely black, preceding segments yellow to red, or dark only below; galeae lightly shagreened, shiny, with long hairs hooked near tips,  
*terminata*, n. sp.  
Last two flagellar segments not contrasting sharply with preceding segments in color; galeae various, usually without hooked hairs ..... 45
- 45(44). Metasomal terga with apical areas deeply infumate..... 46  
Terga with apical areas hyaline, only slightly infumate at most ..... 47
- 46(45). Galeae with long hairs dorsally some of which are bent or hooked near tips.....*moorei* Cockerell  
Galeae with short, straight hairs dorsally.....*exilis*, n. sp.
- 47(45). Last exposed sternum with strong oblique lateral lamelliform carinae as high as apical area of sternum just posterior to each carina, at least twice as long as gap between carinae and with area between carinae dulled by punctation and dense, irregular shagreening ..... *micheneri*, n. sp.  
Last exposed sternum with oblique lateral carinae weak, not high and sharp, less than twice as long as gap between their apices; area between carinae at least partly shiny.. 48
- 48(47). Clypeus entirely black; first flagellar segment at base distinctly narrower than width of median ocellus (measure flagellar segment at extreme base in lateral view); metasomal tergum 2 with distal white pubescent band well-separated from margin of tergum by zone of short, appressed, simple, black or dark brown hairs...*personatella* Cockerell  
Clypeus usually not all black, *if* all black, *then* first flagellar segment laterally at base at least as broad as median ocellus and usually broader; tergum 2 with distal pale band arched, usually reaching apex laterally, often interrupted, 49



- 49(48). Shortest length first flagellar segment usually equals  $\frac{1}{2}$  or less of longest length second segment; flagellar segments entirely black except small ventral pale spot; small bees 8 to 12 mm. in length ..... *microsticta* Cockerell  
 Shortest length first flagellar segment often equals more than  $\frac{1}{2}$  longest length second segment; antennae usually not entirely black, or if so, then not with pale spots ventrally; larger bees, 11 to 14 mm. in length ..... 51
- 50(43). Flagellar segments 5-10 nodose; minimum length first flagellar segment more than  $\frac{1}{2}$  maximum length second segment ..... *hurdi*, n. sp.  
 Flagellar segments 5-10 not nodose; minimum length first flagellar segment equals  $\frac{1}{2}$  or less of maximum length second segment ..... 51
- 51(49, 50). Tergum 2 with depressed area at extreme base (under edge of tergum 1 unless untelescoped) with coarse, round punctures separated mostly by one puncture width or less; antennae never entirely black, usually red at least below .. 52  
 Tergum 2 with depressed area at extreme base with minute, round punctures separated by more than one puncture width and often by 2 or 3 puncture widths or more; antennae often entirely black or dark brown ..... 53
- 52(51). Pale head and thoracic hairs white; clypeus with surface dulled by dense transverse shagreening,  
*gelida*, n. sp. (in part)  
 Pale head and thoracic hairs ochraceous to pale fulvous; clypeus shiny or moderately shiny, shagreening absent or sparse and coarse ..... 86
- 53(51). Clypeus with surface dulled by dense reticular shagreening; supraclypeal area dulled by dense reticular shagreening; mesepisterna with surfaces usually with delicate, sparse shagreening; Baja California ..... *comata*, n. sp.  
 Clypeus and supraclypeal area often with surfaces shiny, unshagreened; mesepisterna without shagreening; United States and Mexico ..... *confusa* Cresson
- 54(39). Pygidial plate broader at extreme base than median length; mandible black basally, labrum cream-colored with black apical margin; galeae shiny, unshagreened; wing veins yellow or red; head and thorax without black hairs,  
*brevipyga*, n. sp.  
 Pygidial plate as long as width at base or longer, *if* broader at base than long (rare), *then either* mandible yellow at base, *or* labrum all black, *or* galeae dulled by shagreening, *or* wing veins brown to black; vertex, mesoscutum and/or scutellum often with dark hairs ..... 55
- 55(54). Labrum largely or wholly white or cream-colored, more than 0.6 times as long as broad; pygidial plate narrow,  $\frac{2}{3}$  or less as broad at base as long; mandible with basal yellow spot; galeae shiny, unshagreened except at tips; wing veins dark

brown; vertex of head, thorax and terga often with dark brown hairs ..... *velutina* (Cockerell)

Labrum entirely black, or 0.6 times as long as broad or shorter, *or* pygidial plate more than  $\frac{2}{3}$  as broad as long, *or* galeae dulled by shagreening, *or* mandibles without yellow spots, *or* wing veins pale; head, thorax and metasomal terga with or without dark hairs; not with the combination given above ..... 56

56(55). Minimum length first flagellar segment half as long as its own maximum length and no longer than pedicel on that side; galeae shiny above, without shagreening except near tips; metasomal tergum 2 with pale pubescent band less than half as wide medially as apical area; terga 2 and 3 with interband zones dulled by dense shagreening, impunctate or punctures shallow and obscured by shagreening; apical areas terga 2-5 dulled by dense, fine reticular shagreening ..... 57

Minimum length first flagellar segment equals more than half maximum length first segment and longer than pedicel on same side, *if* short, *then either* with galeae dulled by shagreening, *or* tergum 2 with pale band broader than half of apical area, *or* terga 2 and 3 with interband zones shiny or moderately so with distinct punctures; apical areas of terga 2-5 usually moderately shiny to shiny ..... 59

57(56). Mandible usually with small yellow basal spot; clypeus dulled by transverse shagreening in interpunctural areas, punctures small; labrum with pale mediobasal spot, *gelida*, n. sp. (in part)

Mandible without basal yellow spot; clypeus shiny to moderately so, with no or little shagreening dulling surface, punctures coarse; labrum with or without pale spot ..... 58

58(57). Medium-sized to large bee, 12-14 mm. in length; tergal apices usually yellow; tergum 1 with apical hairs thickly plumose; minimum length first flagellar segment usually equals  $\frac{1}{7}$  or more maximum length second segment, *submenuacha* Cockerell (in part)

Small to medium-sized bees, 9-13 mm. in length; tergal apices usually colorless; tergum 1 with apical hairs sparse, not thickly plumose; minimum length first flagellar segment usually equals less than  $\frac{1}{7}$  maximum length second segment ..... *coreopsis* Robertson

59(56). Metasomal terga 2 and 3 with interband zones with deep punctures of irregular size but many as large and almost as deep as mesoscutal punctures; terga 3 and 4 with basal depressed areas with punctures fully as large and deep as mesoscutal punctures; apical areas of terga smooth, shiny, impunctate; last exposed sternum coarsely punctate; mandible and labrum black; galeae shiny above, unshagreened, *perpolita*, n. sp.

- Metasomal terga 2 and 3 with interband zones variously punctured but punctures not nearly as large as mesoscutal punctures; terga 3 and 4 with basal areas with punctures much smaller than mesoscutal punctures; apical areas variously punctate; last exposed sternum usually not coarsely punctate; mandibles, labrum and galeae various; not with the combination of characters given above. . . . . 60
- 60(59). Mandible with basal yellow spot *and* labrum with large mediobasal pale spot (as large as  $\frac{1}{3}$  area of labrum and usually larger) . . . . . 61
- Mandible without yellow basal spot *and* labrum with or without pale mediobasal spot (rarely both mandible and labrum with pale spots, but then pale labral spot equals less than  $\frac{1}{3}$  of area of labrum and/or mandibular spots minute; also rarely with labrum black and mandible with minute yellow spot) . . . . . 68
- 61(60). Galeae dulled above by fine reticular shagreening; wing veins red to yellow; hairs of head and thorax usually pale ferrugineous or at least ochraceous. . . . . *agilis* Cresson
- Galeae shiny above, not dulled by shagreening except at tips, *or, if* shagreened, *then* either wing veins brown to black or head and thoracic hairs white or with some dark brown admixed . . . . . 62
- 62(61). Flagellar segment 1 with maximum length equal to about or almost  $\frac{1}{3}$  maximum length flagellar segment 3, with minimum length segment 1 much longer than pedicel on same side; large bee, 12-15 mm. in length,  
*menuachus* Cresson (in part)
- Flagellar segment 1 with maximum length equal to much less than  $\frac{1}{3}$  maximum length flagellar segment 3, with minimum length scarcely, if at all, exceeding length of pedicel on same side; small to medium-sized, 8-13 mm. in length . . . 63
- 63(62). Tergum 2 with distal pale band as broad or broader than apical area medially; clypeus with large deep punctures, surface usually shiny, unshagreened; thoracic hairs above usually very pale ochraceous. . . . . 64
- Tergum 2 with distal pale band narrower than apical area medially, *or, if* about as broad, *then* clypeus with shallow punctures and surface dulled by fine shagreening; thoracic hairs usually white. . . . . 66
- 64(63). Pygidial plate as broad at base as long or slightly broader; mesoscutum with posteromedian area with punctures crowded, separated mostly by half a puncture width or less . . . . . *pexa*, n. sp.
- Pygidial plate narrower than long and/or mesoscutal punctures less crowded, separated mostly by more than half a puncture width. . . . . 65
- 65(64). Mandible with basal yellow macula large, almost forming a complete band across base of mandible; tergum 1 with



- plumose hairs obscuring apical margin, extremely dense and highly branched . . . . . *verbesinarum* Cockerell (in part)
- Mandibular basal yellow spot small, distinctly triangular; tergum 1 with apical band less dense and hairs less branched . . . . . *humilior* Cockerell
- 66(63). Wing veins all pale, yellow to orange; galeae often with delicate, reticular shagreening above . . . . . *snowii* Cresson
- Wing veins red to brown (especially forewings), if mostly pale, at least subcostal vein and pterostigma reddish brown; galeae usually shiny, unshagreened above . . . . . 67
- 67(66). Terga 2-5 with apical areas always colorless, hyaline; terga 6 and 7 often with brown hairs; terga 2-4 often with hairs of interband zones yellow to brown,
- . . . . . *verbesinarum* Cockerell (in part)
- Terga 2-5 with apical areas often infumate; terga 6 and 7 with hairs white to yellow; terga 2-4 with hairs of interband zones white . . . . . *nivea* Robertson
- 68(60). Vertex, tegulae, mesoscutum and scutellum with abundant dark brown hairs, and/or antennae wholly dark brown to black . . . . . 69
- Tegulae without dark hairs, vertex with few or no dark hairs, mesoscutum and scutellum usually without dark hairs; antennae always at least red below and dark above, often wholly pale . . . . . 70
- 69(68). Tergum 2 with depressed basal area with large round punctures separated mostly by one puncture width or less; flagellar segments always pale at least below,
- . . . . . *montana* Cresson (in part)
- Tergum 2 with basal depressed area with punctures minute and separated mostly by 2 or more puncture widths; flagellar segments often entirely dark brown or black,
- . . . . . *confusa* Cresson (in part)
- 70(68). Metasomal tergum 1 with apical  $\frac{1}{4}$  to  $\frac{1}{2}$  medially with short, relatively simple, brown to black, appressed to subappressed hairs; terga 2-5 often with apices slightly or deeply infumate . . . . . 71
- Metasomal tergum 1 with apical  $\frac{1}{4}$  to  $\frac{1}{2}$  medially with long, relatively plumose, white or pale ochraceous hairs, or bare; apical areas terga 2-5 usually colorless, rarely slightly infumate . . . . . 73
- 71(70). Galeae usually dulled by dense tessellation above; hairs of posterior basitarsus along posterior margin much shorter than tibial spurs . . . . . *fumosa*, n. sp. (in part)
- Galeae shiny, unshagreened except at tips and laterally; hairs posterior of hind basitarsus often as long as tibial spurs or longer . . . . . 72
- 72(71). Tergum 2 with distal pale band narrowly interrupted medially; hind basitarsus with hairs of posterior margin distinctly longer than tibial spur . . . . *interrupta*, n. sp. (in part)

Tergum 2 with distal pale band not interrupted medially (unless worn); hairs along posterior margin hind basitarsus no longer than tibial spur or shorter,

*montana* Cresson (in part)

- 73(70). Length forewing plus tegula equals 1.0 cm. or more, large bees; tergum 1 with apical area obscured by several rows of short, highly plumose, appressed hairs; tergum 2 with apical  $\frac{3}{4}$  or more hyaline, yellowish; terga 2-4 with interband zones impunctate or punctures minute and obscured by dense shagreening; first flagellar segment equals little more than pedicel on same side; wing veins red,

*submenuacha* Cockerell (in part)

Medium-sized to small bees, length forewing plus tegula less than 1.0 cm.; tergum 1 with apical area not hidden by plumose hairs; tergum 2 usually with apical hyaline area equal to less than  $\frac{3}{4}$  length of tergum, usually colorless; terga 2-4 with interband zones with distinct punctures or wing veins reddish brown to black . . . . . 74

- 74(73). Minimum length first flagellar segment no longer (or scarcely longer) than pedicel on that side, half as long as maximum length and  $\frac{3}{4}$  or less as long as maximum length segment 2; galeae unshagreened above; labrum usually entirely black; tergum 2 with minute punctures separated by 3 or more puncture widths in interband zone; tergum 2 usually with brown hairs in interband zone and often in apical area as well . . . . . *limbus*, n. sp.

Minimum length flagellar segment 1 usually distinctly longer than pedicel on that side, usually longer than half maximum length, and greater than  $\frac{3}{4}$  maximum length segment 2; galeae often shagreened above; labrum often with pale median spot; tergum 2 with punctures and hair color variable, but not with combination of characters given above . . . 75

- 75(74). Tergum 2 with punctures of interband zone minute, separated mostly by 3 puncture widths or more, scarcely broader than bases of hairs arising from them; terga 3 and 4 with punctures of interband zones minute to small, separated mostly by about 2 puncture widths (often less on tergum 4), indistinct and shallow . . . . . 76

Tergum 2 with interband zone punctures larger, separated mostly by 2 or less puncture widths, distinctly broader than bases of hairs arising from them; terga 3 and 4 with large, round, deep punctures separated mostly by 1 puncture width; or if terga 2, 3 and 4 with minute well-separated punctures, then wing veins yellow to red and bee of medium size . . . . . 77

- 76(75). Labrum usually without pale median spot or spot less than  $\frac{1}{4}$  of area of labrum; galeae dulled by dense reticular shagreening above; pygidial plate broad, width usually more than  $\frac{3}{4}$  length . . . . . *utahensis*, n. sp.

Labrum with pale median spot and spot usually equals  $\frac{1}{2}$  or more of area of labrum; galeae shiny above, unshagreened except at tips; pygidial plate usually narrow, width usually equals less than  $\frac{2}{3}$  length and often as little as  $\frac{1}{2}$  of length,

*vernalis*, n. sp.

- 77(75). Terga 2-4 with interband zones impunctate or with minute punctures scarcely broader than bases of hairs arising from them, separated by 2 to 4 puncture widths, surface dulled by fine tessellation; wing veins red; galeae shiny above except at tips ..... *perlusa* Cockerell (in part)

Terga 2-4 with interband zones with distinct punctures separated mostly by one puncture width or less (especially on terga 3-4), surface shiny or dulled by reticular shagreening; wing veins yellow to dark brown; galeae shiny or dull, shagreened or unshagreened..... 78

- 78(77). Pygidial plate broader at base than median length; wing veins brown to reddish brown; galeae shiny, unshagreened above except at tips; dorsum of thorax with hairs yellow; tergal vestiture ochraceous; tergum 2 with interband zone punctures deep, round, separated mostly by less than one puncture width ..... *relucens*, n. sp.

Pygidial plate at least as long as broad and usually longer, if broader at base than long, then wing veins yellow to red or galeae dulled by fine shagreening above; hairs of thorax and terga various in color; tergum 2 with interband zone punctures usually separated by about one puncture width ..... 79

- 79(78). Flagellar segment 1 with minimum length equal to  $\frac{1}{2}$  or less of maximum length segment 2 and scarcely longer than pedicel on same side; galeae often shagreened at least on apical halves above; labrum with mediobasal pale spot; terga 2-5 with apices often infumate, yellowish brown to yellow ..... 80

Flagellar segment 1 with minimum length equal to more than  $\frac{1}{2}$  and usually more than  $\frac{1}{4}$  maximum length segment 2, usually distinctly longer than pedicel on same side; labrum with or without pale spot; galeae often shiny, unshagreened; tergal apices usually colorless..... 81

- 80(79). Tergum 2 with interband zone with erect to suberect, long, white hairs ..... *elegans*, n. sp. (in part)

Tergum 2 with interband zone with erect to suberect, short, brown hairs..... *fumosa*, n. sp. (in part)

- 81(79). Terga 2-5 with at least some of the erect hairs of interband zones brown or black and often with some or all of suberect hairs of apical areas brown as well; veins of hind wing, as well as fore wing, usually dark reddish brown to black; medium-sized bees, hamuli usually with 12 or more hooks .... *montana* Cresson (in part)

Terga 2-5 with erect hairs of interband zones and suberect



- hairs of apical areas (when present) ochraceous or white; veins of hind wings often red to yellow; small to medium-sized bees, hamuli often with 11 or fewer hooks. . . . . 82
- 82(81). Tergum 1 with apical hairs short, appressed, white, dense and plumose so that a distinct white band is formed across entire tergum; tergum 2 with distal pale band at least as broad as apical apubescent area and usually broader; occasionally with brown hairs on mesoscutum and scutellum . . . . . 83
- Tergum 1 with apical hairs dense and plumose only laterally, if at all, medially with hairs sparse and/or barbs minute; tergum 2 with distal pale band often narrower than apical area; dorsum of mesoscutum and scutellum without dark hairs . . . . . 84
- 83(82). Scutellum with brown hairs (at least a few) and mesoscutum often with brown hairs; galeae often dulled by delicate shagreening above. . . . . *lutulenta*, n. sp.
- Mesoscutum and scutellum without brown hairs; galeae shiny above, not shagreened except at tips . . . . . *appressa*, n. sp.
- 84(82). Head and body hairs long, those of middle of vertex (head in facial view) mostly longer than flagellar segment 3; galeae shiny above, unshagreened except at tips; vestiture ochraceous; Mexico. . . . . *rufipes*, n. sp.
- Head and body hairs shorter, those of middle of vertex mostly shorter than flagellar segment 3; galeae shiny or dulled by shagreening; vestiture tawny, ochraceous or white; mostly United States and Canada. . . . . 85
- 85(84). Galeae shiny, unshagreened above except at tips; medium-sized bees, about 11 mm. in length; tergum 1 with apical hairs obscuring surface in lateral thirds or slightly less, not medially; vestiture white to extremely pale ochraceous, . . . . . *bicolorata*, n. sp.
- Galeae usually dulled above by shagreening at least in apical halves; small bees, 9 to 11 mm. in length; tergum without plumose apical hairs obscuring surface at extreme sides; vestiture usually ochraceous to yellow. . . . . *subagilis* Cockerell
- 86(52). Mesoscutum, scutellum and tegulae without dark hairs; terga 6 and 7 with abundant dark brown hairs; Central America . . . . . *persimilis* Cockerell
- Mesoscutum and scutellum and usually tegulae and vertex of head with at least a few dark brown hairs, *if* dark hairs absent, *then* terga 6 and 7 with hairs all pale as well; United States and Mexico. . . . . 87
- 87(86). Tergum 2 with distal pale band not markedly arched or notched along posterior margin, of about same length across tergum and subequal in length to apical area medially; southeastern Mexico. . . . . *floris* Cockerell
- Tergum 2 with distal pale band markedly arched along posterior border so as to be distinctly thinned (rarely interrupted) and shorter than apical area medially; United States and Northern Mexico . . . . . *montana* Cresson (in part)

FEMALES

1. Mesoscutal and scutellar punctures minute, mesoscutum with large posteromedian area impunctate or with scattered punctures less than  $\frac{1}{2}$  diameter of mesepisternal punctures; mesoscutal punctures anteromesad of parapsidal lines no larger and mostly smaller than mesepisternal punctures and separated by 2 to 3 puncture widths or more, *expolita*, n. sp.  
Mesoscutal and scutellar punctures larger or more crowded than described above, or both..... 2
- 2 (1). First three sterna with long apicomedian hairs with curled tips; scopal hairs long, curled near tips, with 2 or 3 branches on each side of rachis; first tergum with sparse minute punctures in basal third or less... *paucipuncta*, n. sp.  
First three sterna with apicomedian hairs not so long, not curled near tips; scopal hairs almost always more abundantly branched, with straight tips; first tergum usually with more abundant and larger punctures in basal third to two-thirds ..... 3
- 3 (2). Thorax with lateral and ventral surfaces, including propodeum, with dark brown or black hairs; terga 2 and 3 with lateral raised areas of interband zones with large, piliferous punctures, surfaces shiny, with no tessellation nor shagreening; supraclypeal area shiny, unshagreened, *hymenoxidis* Cockerell  
Thorax with entire lateral surface not usually with dark brown to black hairs, *if so, then* terga 2 and 3 with raised lateral areas of interband zones with surfaces at least slightly dulled by shagreening or tessellation or shiny but with extremely fine shagreening; supraclypeal area variously sculptured..... 4
- 4 (3). Terga without complete pale pubescent bands, these being reduced to lateral fasciae or absent completely; or, *if* one complete band present, *then* it is band of tergum 2 and lower lateral mesepisternal surfaces with dark brown hairs, 5  
Terga with complete pale pubescent bands on more than one tergum, *if* complete on only one tergum, *either* not on tergum 1, *or* lower lateral mesepisternal surfaces without dark hairs ..... 12
- 5 (4). Scopal hairs fuscous or almost entirely so..... 6  
Scopal hairs pale or mostly pale (those of basitarsi often mostly or entirely dark brown)..... 8
- 6 (5). Thorax above, including dorsal and posterior faces of propodeum and often upper parts of mesepisterna, pale ochraceous to slightly ferrugineous (fox-red), laterally and ventrally dark brown to black; medium-sized bee, 11 to 13 mm. in length ..... *bicolorata*, n. sp.  
Thorax mostly dark brown to black, occasionally with paler hairs peripherally on scutellum, near bases of tegulae and

- on dorsum of propodeum; small bees, 9 to 12 mm. in length ..... 7
- 7 (6). Wing membranes deeply infumate, dark brown; clypeus with surface dulled by coarse reticular shagreening; Cuba, *pullata* Cresson  
Wing membranes only slightly infumate near tips; clypeus shiny, at most with delicate shagreening; Oregon, *pullatella*, n. sp.
- 8 (5). Tergum 1 with punctures of anterior half large, rounded, mostly separated by about  $\frac{1}{2}$  a puncture width, surface only delicately shagreened, shiny ..... *dentiventris* Smith  
Tergum 1 with punctures of anterior half smaller, usually separated by much more than half a puncture width and often by more than one puncture width, or irregular, surface dulled by dense reticulotransverse shagreening which often obscures punctures ..... 9
- 9 (8). Terga 2-4 with apical areas shiny, impunctate, without hairs, slightly translucent, reddish brown in color; clypeus not at all protruding ..... *rustica* (Say) (in part)  
Terga 2-4 with apical areas moderately dulled by coarse shagreening, or with short, appressed or subappressed hairs, or punctate, or all of these; clypeus occasionally protruding by almost  $\frac{1}{2}$  width of eye in profile ..... 10
- 10 (9). Mesoscutum with surface distinctly shagreened (reticularly); small bees, 10-12 mm. in length; thorax with dorsum with most hairs ferrugineous (more rarely ochraceous) ..... 11  
Mesoscutum with surface unshagreened; shiny; medium-sized bees, 11-14 mm. in length; thorax with dorsal hairs mostly pale ochraceous, never ferrugineous, *bimatrix*, n. sp. (in part)
- 11(10). Galeae shiny, unshagreened except at tips. . . *bidentis* Cockerell  
Galeae dulled by dense shagreening, *trinodis* Robertson (in part)
- 12 (4). Flagellar segment 2 slightly but distinctly longer than wide; hairs of inner surfaces hind basitarsi brown or dark brown, 13  
Flagellar segment 2 as wide as long or wider and/or hairs of inner surfaces hind basitarsi yellow to dark red ..... 18
- 13(12). Terga 2 and 3 with apical areas with abundant, suberect, dark brown to black hairs; pygidial plate acutely V-shaped, 14  
Terga 2 and 3 with apical areas apubescent or with white or ochraceous, suberect hairs; pygidial plate V-shaped, but apex rounded, not acute ..... 15
- 14(13). Galeae dulled by dense tessellation ..... *micheneri*, n. sp.  
Galeae shiny, not tessellate, unshagreened or at most only lightly so ..... *exilis*, n. sp.
- 15(13). Mesoscutum without dark hairs (or extremely few) and often none on scutellum; forewing and tegulae measures 11 mm. or more in length ..... 16  
Mesoscutum with large patch of dark brown hairs, scutellum also with dark hairs; forewing plus tegula measures less than 11 mm. in length ..... 17



- 16(15). Terga 6 and 7 with lateral tufts of pale ochraceous to white hairs; mesepisterna without dark hairs. . . . . *menuachus* Cresson  
Terga 6 and 7 without lateral tufts of pale hairs; mesepisterna with lower-lateral parts with dark brown to black hairs, . . . . . *semilupina* Cockerell
- 17(15). Posterior pronotal lobes with black hairs mixed with the pale; mesoscutal dark hair patch reaching tegulae laterally or almost so; clypeal punctures large, round, separated by about half a puncture width, surface shiny, unshagreened or only slightly so. . . . . *perpolita*, n. sp.  
Posterior pronotal lobes without black hairs; mesoscutum without large brown patch posteromedially; clypeal punctures small and crowded, surface dulled by dense reticular shagreening. . . . . *cerussata*, n. sp.
- 18(12). Scopal hairs with branches gently deflected outward from rachis and hooked downward toward tips so as to appear somewhat S-shaped (especially on upper half of basitarsi and medially on tibiae), branches short, abundant; terga 2 and 3 with apical areas broad, impunctate and apubescent; inner surfaces hind basitarsi with hairs dark brown to black . . . . . 19  
Scopal hairs with straight branches originating in a sharp angle to rachis, or *if* somewhat S-shaped, *then either* terga 2 and 3 with apical areas punctate or pubescent *or* with inner surfaces hind basitarsi with yellow to red hairs, 20
- 19(18). Posterior lobes of pronotum almost always with black hairs (at least one present); outer surfaces middle basitarsi with hairs dark brown; small bees, hamuli usually with 11-12 hooks, rarely 13 . . . . . *denticulata* Smith  
Posterior lobes pronotum usually without black hairs; outer surfaces middle basitarsi with hairs cinereous to pale brown, never dark; medium-sized bees, hamuli usually with 13-15 hooks. . . . . *vernoniae* Robertson
- 20(18). Tergum 1 with apical area broadly hyaline, colorless; inner surfaces hind basitarsi with hairs dark brown or black; clypeus with shiny median boss; vestiture ochraceous to white . . . . . *tristis* Cockerell  
Tergum 1 with apical margin usually opaque, *if* hyaline, only narrowly so *or* inner surfaces hind basitarsi with hairs yellow to red, *or* clypeus without shiny median boss; vestiture variously colored . . . . . 21
- 21(20). Tergum 3 with apical area with (a) dark hairs across entire tergum or at least across median third or more, *or* (b) with pale hairs which do not completely obscure surface and which differ from hairs of distal pale band by being less plumose and more erect, *or* (c) with no hairs or punctures and apical apubescent area longer than distal pale band of tergum 2 at least medially. . . . . 22  
Tergum 3 with apical area covered by distal pubescent band which is apical, *if* with apical area not covered by distal

- pale band, *then either* (a) apical area apubescent, impunctate, and shorter across tergum than distal pale band of tergum 2, *or* (b) apubescent, impunctate *and* broadly triangular in shape but no wider than  $\frac{1}{3}$  width of tergum (distal pubescent band reaching margin of tergum in lateral thirds) . . . . . 55
- 22(21). Mesoscutum without patch of dark brown to black hairs posteromedially, or few if any present; clypeus often protrudes slightly, in profile by as much as  $\frac{1}{2}$  width of eye . . . 23
- Mesoscutum with distinct patch of dark brown to black hairs posteromedially; clypeus rarely protruding by as much as  $\frac{1}{2}$  width of eye in profile . . . . . 30
- 23(22). Tergum 1 with impunctate apical area equal to more than half of basal punctate area medially; tergum 3 often without dark hairs in apical area . . . . . 24
- Tergum 1 with impunctate apical area equal to half or less of basal punctate area medially; tergum 3 with apical area often with suberect dark hairs . . . . . 27
- 24(23). Thoracic hairs white; metasomal pubescent bands white; terga 2 and 3 with apical areas with suberect hairs simple, white or brown . . . . . *snowii* Cresson
- Thoracic hairs pale to bright ferrugineous or ochraceous; metasomal pubescent bands usually yellowish; terga 2 and 3 with apical area hairs golden or brown, often with short distinct barbs . . . . . 25
- 25(24). Veins of hind and fore wings dark brown to black; metasomal sternal hairs mostly dark brown to black; tergum 4 with pale apical band notched medially with area of dark brown to black hairs; terga 2 and 3 with apical areas with dark suberect hairs . . . . . *trinodis* Robertson (in part)
- Veins of hind and fore wings mostly red; metasomal sternal hairs mostly ferrugineous or paler, occasionally dark brown; terga 2, 3 and 4 with apical areas with no suberect hairs or these pale in color . . . . . 26
- 26(25). Galeae shiny above, unshagreened except at tips; terga 2 and 3 with apical areas with suberect hairs long (of about same length as those of distal pubescent band) and abundant (obscuring surface, especially on tergum 3),  
*perlusa* Cockerell
Galeae dulled above by dense shagreening; terga 2 and 3 with apical areas with suberect hairs shorter and less abundant, scarcely obscuring surfaces . . . . . *agilis* Cresson
- 27(23). Terga 2 and 3 with apical areas impunctate and without suberect hairs . . . . . *ochraea*, n. sp.
- Terga 2 and 3 with apical areas punctate and/or with suberect hairs . . . . . 28
- 28(27). Terga 2 and 3 with apical areas with suberect, long, pale hairs; flagella usually entirely dark brown to black,  
*bimatrix*, n. sp. (in part)
Terga 2 and 3 with apical areas with dark brown, suberect hairs; flagella usually red below . . . . . 29

- 29(28). Terga 2 and 3 with apical areas with suberect hairs arising from small but distinct punctures; galeae usually dulled by shagreening ..... *hurdi*, n. sp.  
 Terga 2 and 3 with apical areas with suberect hairs not arising from distinct punctures; galeae usually shiny, unshagreened except at tips ..... *submenuacha* Cockerell
- 30(22). Galeae dulled by dense regular tessellation, with long hairs some of which are bent or hooked near tips; terga 2 and 3 with apical areas with abundant, long dark brown to black, suberect hairs arising from minute but distinct punctures; vertex of head and tegulae with abundant dark brown hairs ..... *moorei* Cockerell  
 Galeal sculpturing various, without hooked hairs, or, *if* tessellate and with hooked hairs, *then* terga 2 and 3 with apical areas impunctate or without dark hairs or both; vertex and tegulae often without dark hairs ..... 31
- 31(30). Pygidial plate acutely V-shaped; medial tibial scopal hairs reddish brown, anterior and posterior hairs golden yellow; terga 2 and 3 with apical areas with subappressed, dark brown hairs; tegulae testaceous ..... *crocina*, n. sp.  
 Pygidial plate V-shaped or U-shaped, *if* V-shaped not acutely so, but apex rounded; medial tibial scopal hairs as pale as other scopal hairs; terga 2 and 3 with apical areas various; tegulae usually piceous ..... 32
- 32(31). Small bees, forewing plus tegula measures about 8 mm. in length; vertex of head and tegulae without dark hairs; thoracic pale hairs white or very pale ochraceous; posterior pronotal lobes never with dark hairs. *humilior* Cockerell  
 Usually larger bees, *if* forewing and tegula measures 8 mm. or less in length, *then* vertex of head and tegulae with dark hairs, *or* pale hairs of thorax ferruginous, *or* posterior pronotal lobes with at least a few dark hairs ..... 33
- 33(32). Small bees, forewing plus tegula less than 8 mm. in length; tergum 2 with distal pale band broadly interrupted medially, forming two lateral oblique fasciae tapering mesally and anteriorly, each fascia about as long as distance between their tips, apical area long, glabrous, *fasciatella*, n. sp.  
 Usually larger bees, *if* forewing and tegula measures 8 mm. or less, *then* tergum 2 with distal pale band not broadly interrupted medially, apical area often with hairs ..... 34
- 34(33). Tergum 3 with apical area with abundant simple white hairs arising from small but distinct punctures (hairs may be cinereous or even pale brown medially); tergum 2 with apical area similar but less distinctly punctate; metasomal pale hairs and scopal hairs white; posterior pronotal lobes never with dark hairs ..... *nivea* Robertson  
 Tergum 3 with apical area usually with abundant dark brown hairs, *if* with simple white hairs, *then* these not arising from distinct punctures; metasomal pale hairs and scopal



- hairs often ochraceous to yellow; posterior pronotal lobes often with dark hairs . . . . . 35
- 35(34). Terga 2 and 3 with apical areas long (usually medial length greater than medial length of pale band of tergum 3), apubescent, and impunctate, surface dulled by fine, dense, reticular shagreening, as dull as interband zone of tergum 2 (a few scattered, dark brown, short, appressed hairs may be present but, if so, separated by more than length of one of hairs) . . . . . 36
- Terga 2 and 3 with apical areas *either* (a) short (less than length of distal pale band tergum 3), *or* (b) with abundant hairs, pale or dark, *or* (c) punctate, *or* (d) shiny and distinctly less dulled by shagreening than interband zone of tergum 2, *or* some combination of these . . . . . 38
- 36(35). Tergum 4 with pubescence along apical margin dark brown to black, without apicomedian apubescent area,  
*wheeleri* Cockerell
- Tergum 4 with apicomedian apubescent triangular area, often with a few dark brown hairs along apical margin or in virtually apubescent area . . . . . 37
- 37(36). Tergum 4 with apical apubescent area with abundant, minute punctures obscured by dense tessellation; tergum 2 with interband zone with distinct punctures; mesepisterna usually dulled by fine irregular shagreening,  
*illata* Lovell and Cockerell
- Tergum 4 with apical apubescent area impunctate, surface dulled by dense shagreening as in terga 2 and 3, tergum 2 with interband zone virtually impunctate; mesepisterna with surfaces usually shiny, unshagreened . . . *subillata*, n. sp.
- 38(35). Tergum 2 with apical area impunctate and without hairs (a very few short dark appressed hairs may be present near distal pale band), shiny, extremely finely reticulotransversely shagreened; tergum 2 with interband zone with surface dulled by dense reticular shagreening contrasting with shiny apical area; vertex of head and tegulae with abundant dark brown to black hairs . . . . . 39
- Tergum 2 with apical area either punctate or with abundant appressed to suberect, pale to dark hairs, often dulled by shagreening, *if* glabrous, shiny and impunctate, *then* tergum 2 with interband zone with surface also shiny, not contrasting with apical area; vertex of head and/or tegulae often without dark hairs . . . . . 40
- 39(38). Tergum 3 with distal pubescent band usually reaching apical margin at extreme sides; pale mesoscutal hairs anterior to dark patch white to pale ochraceous; scopal hairs ochraceous; tergum 1 with punctures small, separated by about half a puncture width but distinct, surface reticularly shagreened . . . . . *pallidisignata* Cockerell (in part)
- Tergum 3 with distal pubescent band well-separated from apical margin across entire tergum; pale mesoscutal hairs

- anterior to dark patch often ferrugineous; scopal hairs usually golden yellow; tergum 1 with basal area punctures large, extremely shallow, crowded, obscured by dense, reticular shagreening ..... *rustica* (Say)
- 40(38). Tergum 2 with interband zone with distinct, round, regular punctures across entire tergum, may be sparser medially than laterally ..... 41
- Tergum 2 with interband zone impunctate or punctures indistinct or irregular in shape and size, or restricted to lateral raised areas ..... 50
- 41(40). Tergum 3 and often tergum 2 with apical area distinctly punctate, punctures at least slightly greater in diameter than hairs arising from them ..... 42
- Terga 2 and 3 with apical areas impunctate or with minute punctures scarcely greater in diameter than hairs arising from them ..... 47
- 42(41). Small bees, forewing plus tegula equals 8 mm. or less, dorsal thoracic hairs (especially pale hairs) blunt, branches extremely short and abundant making hairs appear thick and clipped; clypeus flat, shiny, punctures coarse, shagreening sparse, delicate and irregular, ..... *paulula*, n. sp.
- Small to large bees, if forewing plus tegula 8 mm. or less, then dorsal thoracic hairs with longer, sparser branches thus appearing thinner and sharply pointed; clypeus often slightly bowed outwards, punctures variable, surface often dulled by reticular shagreening ..... 43
- 43(42). Tergum 1 with basal area punctures large and deep, medially as large or larger than scutellar punctures but not as deep, well-separated and not obscured by shagreening ..... 44
- Tergum 1 with basal area punctures small and shallow, medially distinctly smaller than scutellar punctures, crowded and often obscured by dense shagreening ..... 45
- 44(43). Posterior lobes of pronotum usually with at least one long black hair mixed with the pale; galeae dulled by tessellation ..... *boltoniae* Robertson
- Posterior lobes of pronotum never with black hairs; galeae with at least basal half shiny and not tessellate or shagreened, apical half or less often dulled by fine reticular shagreening ..... *fumosa*, n. sp.
- 45(43). Galeae shiny, unshagreened above except near tips; tergum 2 with interband zone punctures small, in median third separated mostly by 2 to 3 puncture widths, laterally by 1 to 2 puncture widths, tergum 4 fringed with black hairs ..... *pilleata*, n. sp.
- Galeae dulled above by fine reticular shagreening at least in apical third to one-half; tergum 2 with interband zone punctures slightly larger, in median third separated mostly by 1 to 2 puncture widths and laterally by 1 puncture

- width or less; tergum 4 with or without fringe of black hairs ..... 46
- 46(45). Terga 5 and 6 with small lateral tufts of white hairs; mesoscutal dark patch twice as large as scutellar dark patch or almost so (sometimes larger); mesoscutum with pale hairs white to pale ochraceous ..... *tinctoria*, n. sp.
- Terga 5 and 6 without lateral pale hair tufts; mesoscutal dark hair patch equals scutellar dark patch or only slightly larger; mesoscutal pale hairs ochraceous to dull ferruginous ..... *manipularis* Smith
- 47(41). Clypeus with large crowded punctures, surface shiny, unshagreened; tergum 2 with interband zone punctures regular in size and spacing, not sparser medially; scopal hairs white ..... *pexa*, n. sp.
- Clypeus with punctures often small, surface usually somewhat dulled by shagreening, *if* surface shiny and unshagreened, *then* tergum 2 with punctures of interband zone somewhat sparser medially than laterally; scopal hairs often pale ochraceous ..... 48
- 48(47). Galeae shagreened in apical half or more; tergum 2 with interband zone punctures not markedly sparser medially than laterally, with distal pubescent band usually not interrupted medially ..... *elegans*, n. sp.
- Galeae shiny, unshagreened except at tips; tergum 2 with interband zone punctures somewhat sparser medially than laterally, with distal pale band often narrowly interrupted medially ..... 49
- 49(48). Wing membranes somewhat infumate, yellowish brown; inner surfaces hind basitarsi with hairs orange to dark red ..... *montana* Cresson
- Wing membranes clear, not infumate; inner surfaces hind basitarsi with hairs dark reddish brown to black, *coreopsis* Robertson
- 50(40). Galeae dulled by dense, coarse shagreening or tessellation, *robustior* Cockerell
- Galeae shiny, unshagreened except at tips or only extremely delicately so ..... 51
- 51(50). Tergum 3 and usually 2 with apical area with hairs white to brown, long and silky, suberect, often curved away from surface; pale body hairs and scopal hairs white; clypeal punctures small, surface dulled by dense reticular shagreening ..... *gelida*, n. sp.
- Terga 2 and 3 with apical area hairs dark brown to black, short, subappressed, straight, not silky but appearing rigid; pale mesoscutum and often scopal hairs ochraceous to pale ochraceous ..... 52
- 52(51). Small bees, wing plus tegula measures 8 mm. or less in length; tergum 3 with apical area less than half length of distal pale band medially, with short subappressed brown hairs arising from minute punctures ..... *limbus*, n. sp.



- Larger bees, *if* wing plus tegula measures 8 mm. or less, *then* tergum 3 with apical area at least half as long as distal pale band medially *or* provided with subappressed black hairs but not punctate at all..... 53
- 53(52). Terga 5 and 6 without lateral tufts of pale hairs; mesepisterna and clypeus often with lower parts with dark brown to black hairs; flagellum often dark brown to black below .....*confusa* Cresson
- Tergum 5 and usually tergum 6 with lateral tufts of pale hairs; mesepisterna and clypeus usually without dark hairs; flagellum usually red below..... 54
- 54(53). Tergum 2 with distal pale band distinctly and abruptly interrupted medially (lateral fasciae not tapered to mid-line); mesepisterna without dark hairs below; inner surfaces hind basitarsi with hairs orange to red, *interrupta*, n. sp.
- Tergum 2 with distal pale band not interrupted medially, *or* if so, *then* lateral fasciae tapered to midline; mesepisterna often with dark brown hairs below, inner surfaces hind basitarsi with hairs dark reddish brown to black, *persimilis* Cockerell
- 55(21). Terga 2-4 with apical areas translucent, colorless to pale yellowish brown; inner surfaces hind basitarsi with hairs yellow to red..... 56
- Terga 2-4 with apical areas piceous, *if* somewhat translucent, *not* pale yellowish brown but dark brown and opaque; inner surfaces hind basitarsi with hairs often dark brown to black..... 58
- 56(55). Mesoscutum with no or few dark brown hairs; terga 2 and 3 with apical areas with hairs white; terga 5 and 6 with hairs white to ochraceous.....*saponellus* Cockerell
- Mesoscutum with large patch of brown hairs; terga 2 and often 3 with apical area hairs dark brown; terga 5 and 6 often with dark brown hairs..... 57
- 57(56). Wing membranes somewhat infumate; terga 3-5 with basal areas (*e. g.* usually telescoped under preceding segment) with white hairs; clypeus somewhat bowed outwards, *velutina* (Cockerell)
- Wing membranes colorless, clear; terga 3-5 with basal area hairs brown; clypeus relatively flat.....*vernalis*, n. sp.
- 58(55). Small bees, forewing plus tegula measures 7.0 to 8.5 mm. in length; pygidial plate acutely V-shaped; flagellum dark reddish brown to black except small dark red ventral spot on segments 3 to 10; tergum 2 with distal pubescent band narrowly interrupted medially; inner surfaces hind basitarsi with dark hairs.....*microsticta* Cockerell
- Small to medium-sized bees; *if* forewing plus tegula measures 8.5 mm. or less, *then* pygidial plate not acutely V-shaped but with apex rounded, and/or flagellum dark red below; tergum 2 often with distal pale band uninter-

- rupted; inner surfaces hind basitarsi often with yellow to red hairs. . . . . 59
- 59(58). Tergum 2 with interband zone impunctate or virtually so, with dark hairs suberect to erect; inner surfaces hind basitarsi with dark reddish brown to black hairs, *grindeliae* Cockerell
- Tergum 2 with interband zone with distinct punctures, *if* almost impunctate, *then* with hairs pale and/or appressed to subappressed; inner surfaces hind basitarsi often with hairs yellow to red. . . . . 60
- 60(59). Pygidial plate acutely V-shaped; mesoscutum with postero-median area with punctures round, deep, crowded, separated mostly by half a puncture width. . . *relucens*, n. sp.
- Pygidial plate V-shaped but with rounded apex (sometimes worn to acute point), *if* acute, *then* posteromedian area mesoscutum impunctate or with punctures separated mostly by one puncture width or more. . . . . 61
- 61(60). Small bees, forewing plus tegula less than 8 mm. in length; inner surfaces hind basitarsi with hairs yellow to red; galeae dulled by dense tessellation, with long hairs some of which are hooked or bent near tips *melanura* (Cockerell)
- Larger bees, *if* forewing plus tegula measures less than 8 mm. in length, *then either* inner surfaces hind basitarsi with hairs dark brown *and/or* galeae shiny, not tessellate; galeal hairs often short and never hooked near tips . . . . . 62
- 62(61). Medium-sized bees, forewing plus tegula measures 9 to 10 mm. in length; tergum 2 with interband zone with lateral raised areas with distinct punctures of two sizes, one large and seemingly directed somewhat posteriorly, the other minute; inner surfaces hind basitarsi with hairs dark brown . . . . . *pallidisignata* Cockerell (in part)
- Smaller bees, *if* forewing plus tegula equals 9 mm. or more in length, *then* tergum 2 with interband zone impunctate or punctures all of same size, *or* inner surfaces hind basitarsi with hairs yellow to red . . . . . 63
- 63(62). Medium-sized bees, forewing plus tegula measures more than 8 mm. in length; inner surfaces hind basitarsi with hairs yellow to red; tergum 2 with distal pale band extremely narrowly interrupted medially; mesoscutal dark hair patch about equal to scutellar dark patch in size, *rufipes*, n. sp.
- Smaller bees, *if* forewing plus tegula measures more than 8 mm. in length, *then either* inner surfaces hind basitarsi with hairs dark, *or* tergum 2 with distal pubescent band uninterrupted *or* mesoscutal dark hair patch smaller than scutellar dark patch, *or* some combination of these. . . . . 64
- 64(63). Galeae dulled above by dense reticular shagreening; inner surfaces hind basitarsi with hairs usually yellow to red, rarely dark reddish brown; pale vestiture ochraceous to yellow (especially on mesoscutum); mesoscutum usually

- without dark hairs or dark patch smaller than scutellar dark patch ..... *subagilis* Cockerell
- Galeae shiny, not dulled above by dense shagreening except near tips (less than apical half), *if* dulled by shagreening, *then* either inner surfaces hind basitarsi with dark hairs, or pale vestiture white, or mesoscutum with large dark hair patch (at least as large as scutellar dark patch) ... 65
- 65(64). Tergum 2 with interband zone with appressed to subappressed, white pubescence, dark spinelike hairs absent, with distal pale band composed of relatively long, overlapping plumose hairs, not interrupted medially unless worn... 66
- Tergum 2 with interband zone with appressed to subappressed, dark brown to black, spinelike hairs, *or if* dark hairs absent, *then* distal pale band medially composed of short, scalelike, discrete (not overlapping except near base of pale band) hairs, often extremely narrowly interrupted medially ..... 68
- 66(65). Galeae dulled above by shagreening at least in apical third to one-half; mesoscutum usually with dark hairs posteromedially ..... *utahensis*, n. sp.
- Galeae unshagreened except near tips; mesoscutum without dark hairs ..... 67
- 67(66). Tergum 2 with apical area apubescent, shiny, subequal to distal pale band in length medially or longer than half length of distal pale band, interband zone with distinct punctures about equal in diameter to punctures of basal area and separated mostly by half to one puncture width, *brevipyga*, n. sp.
- Tergum 2 with apical area obliterated by distal pale band, or, *if* apubescent, shorter than half length of distal pale band medially, with interband zone with minute punctures distinctly smaller than those of basal area and separated mostly by one or more puncture widths, *verbesinarum* Cockerell
- 68(65). Tegulae with abundant dark brown hairs; tergum 1 with apical area with abundant, short, closely appressed, dark brown hairs ..... *personatella* Cockerell
- Tegulae with hairs white to ochraceous; tergum 1 with apical area apubescent or with appressed hairs white (a few dark brown appressed hairs sometimes present anterolaterally) ..... 69
- 69(68). Terga 2 and 3 with distal pubescent bands at least near midline composed of short, scalelike, appressed, plumose hairs which scarcely overlap laterally or do not; tergum 2 with interband zone punctures regular in size and spacing (often slightly sparser medially) ..... *appressa*, n. sp.
- Terga 2 and 3 with distal pale bands composed of relatively long plumose hairs overlapping laterally, not seemingly scalelike; tergum 2 often with punctures irregular in size and spacing ..... 70



70(69). Mesoscutum with posteromedian area with punctures separated mostly by less than two puncture widths,

*monoensis*, n. sp.

Mesoscutum with posteromedian area punctures separated

mostly by more than two puncture widths . . . *lutulenta*, n. sp.

*Melissodes (Eumelissodes) agilis* Cresson

*Melissodes agilis* Cresson, 1878, Proc. Acad. Nat. Sci. Philadelphia, vol. 30, p. 204; Cockerell, 1894, Ent. News, vol. 5, p. 234; Robertson, 1896, Trans. Acad. Sci. St. Louis, vol. 7, p. 176; Cockerell, 1897, Bull. New Mexico Agric. Exp. Sta., No. 24, pp. 23, 24, 28; 1898, Bull. Univ. New Mexico, vol. 1, pp. 67, 73; 1898, Bull. Sci. Labs. Denison Univ., vol. 11, pp. 67, 73; 1898, Zoologist, ser. 4, vol. 2, pp. 312, 314; Bridwell, 1899, Trans. Kansas Acad. Sci., vol. 16, p. 211; Cockerell, 1900, Entomologist, vol. 33, p. 217; 1901, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 129; 1901, Ent. News, vol. 12, p. 40; Robertson, 1901, Canadian Ent., vol. 33, p. 231; Pierce, 1904, Univ. Nebraska Studies, vol. 4, p. 174; Cockerell, 1905, Bull. S. California Acad. Sci., vol. 4, pp. 13, 28, 29; Robertson, 1905, Trans. Amer. Ent. Soc., vol. 31, p. 369; Lovell and Cockerell, 1906, Psyche, vol. 13, p. 110; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 137; Cockerell, 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 31, 77; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309; 1907, Univ. Colorado Studies, vol. 7, p. 128; 1910, Entomologist, vol. 43, p. 90; Graenicher, 1911, Bull. Publ. Mus. Milwaukee, vol. 1, p. 247; Cockerell, 1914, Ann. Mag. Nat. Hist., series 8, vol. 14, p. 365; Cresson, 1916, Mem. Amer. Ent. Soc., vol. 1, p. 110; Robertson, 1926, Ecology, vol. 7, p. 379; 1928, Flowers and Insects, p. 8; Cockerell, 1928, Psyche, vol. 35, p. 333; Pearson, 1933, Ecol. Monogr., vol. 3, p. 380; Graenicher, 1935, Ann. Ent. Soc. Amer., vol. 28, p. 304; Brimley, 1938, Insects of North Carolina, p. 462; Linsley, 1946, Jour. Econ. Ent., vol. 39, p. 20; Michener, 1947, Amer. Midland Nat., vol. 38, p. 454; Bohart, Knowlton, Bailey, 1950, Utah St. Agric. Coll. Mimeo. Series No. 371, p. 5.

*Melissodes agilis aurigenia* Cresson, 1878, Proc. Acad. Nat. Sci. Philadelphia, vol. 30, p. 212; Robertson, 1894, Trans. Acad. Sci. St. Louis, vol. 6, p. 452; 1897, Trans. Acad. Sci. St. Louis, vol. 7, p. 354; Cockerell, 1897, Bull. New Mexico Agric. Exp. Sta., No. 24, p. 20; 1898, Zoologist, ser. 4, vol. 2, p. 79; 1898, Bull. Univ. New Mexico, vol. 1, pp. 67, 73; 1898, Bull. Sci. Lab. Denison Univ., vol. 11, pp. 67, 73; Robertson, 1898, Botanical Gazette, vol. 25, p. 244; Cockerell, 1901, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 129; 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 12, p. 450; 1905, Bull. S. California Acad. Sci., vol. 4, p. 103; 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 81, 84, 92; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 136; Hart and Gleason, 1907, Bull. Illinois St. Lab. Nat. Hist., vol. 7, p. 257; Tucker, 1909, Trans. Kansas Acad. Sci., vol. 22, p. 278; Cockerell, 1911, Canadian Ent., vol. 43, p. 390; Gibson, 1914, Forty-fourth Ann. Rept. Ent. Soc. Ontario, 1913, p. 125; Cockerell, 1914, Canadian Ent., vol. 46, p. 409; 1915, Ann. Mag. Nat. Hist., ser. 8, vol. 16, p. 482; 1916, Canadian Ent., vol. 48, p. 77; Viereck, 1916, Bull. Connecticut Geol. Nat. Hist. Surv., vol. 22, p. 733; Clements and Long, 1923, Carnegie Inst. of Washington Publ. No. 336, p. 253; Cockerell, 1923, Ent. News, vol. 34, p. 48; 1928, Psyche, vol. 35, p. 333; 1930, Amer. Mus. Nov. No. 397, p. 1; 1933, Ann. Ent. Soc. Amer., vol. 26, p. 44.

*Melissodes pennsylvanica*, Hendrickson, 1930, Iowa St. Coll. Jour. Sci., vol. 4, p. 164 (misidentification).

*Melissodes agilis* is without doubt the most common species of the genus *Melissodes* in North America. The females are distinctive in the usually red thoracic hairs (without posteromedian brown patch), the red to reddish brown wing veins, the dulled galeae and

the ochraceous scopal hairs. The males can be recognized by the hyaline tergal margins, the dulled galeae, the yellow maculae on the mandibles and labrum and the entirely yellow clypeus, the yellow to pale red wing veins, the ochraceous to red thoracic hairs and the short first flagellar segment. Both sexes closely resemble certain other species of the subgenus *Eumelissodes* in one or more of these characteristics. These are discussed in the diagnosis of the species whose descriptions follow that of *agilis*.

*Female*. Measurements and ratios: N, 20; length, 10-13 mm.; width 3.5-4.5 mm.; wing length,  $M = 3.46 \pm 0.159$  mm.; hooks in hamulus,  $M = 13.45 \pm 0.223$ ; flagellar segment 1/segment 2,  $M = 1.81 \pm 0.027$ .

Structure and color: Integument black except as follows: apical half of mandible, lower surface of flagellar segments 3-10 (and often apex of segment 2), and distitarsi rufescent; eyes gray to bluish gray, rarely greenish or black with violet reflections; wing membranes hyaline, colorless, veins red to reddish brown, pterostigma yellow to red; tibial spurs yellow to red.

Clypeus with small round regular punctures separated by half to one puncture width, surface dulled by coarse regular reticular shagreening, often with short median longitudinal carina in apical half, clypeus slightly protruding beyond eyes in profile but by no more than half width of eye; supraclypeal area sculptured as clypeus but often impunctate medially; galeae dulled above by dense, fine tessellation; maxillary palpal segments in ratio of about 4.5:3.5:3.3:1.0; vertex with flattened lateral areas with small round punctures separated mostly by one to three puncture widths, surface dulled by irregular reticular shagreening. Mesoscutum with deep round punctures separated by half to one puncture width, slightly larger and sparser in posteromedian area, surface shiny, sparsely or not at all shagreened; scutellar punctures similar to mesoscutal but slightly more crowded; metanotum with punctures half diameter of scutellar, separated mostly by half to one puncture width, surface dulled by extremely fine, reticular shagreening; propodeum with dorsal surface reticulorugose, coarsely so basally, posterior surface with coarse punctures except upper triangle, lateral surfaces similar to posterior but punctures more crowded, surfaces dulled by dense regular tessellation; mesepisternum with lateral surface with large shallow punctures separated mostly by half a puncture width or less, surface shiny, unshagreened or finely so. Metasomal tergum 1 with basal three-fifths or slightly less punctate (to apex at extreme

sides), punctures round, shallow, separated mostly by one to two puncture widths, surface dulled by fine tessellation, apical area impunctate with surface shiny, extremely finely reticulotransversely shagreened; tergum 2 with basal zone with minute round punctures separated mostly by half to one puncture width, surface shiny but with fine reticular shagreening, interband zone with small irregular punctures separated by one to three puncture widths, sparser medially than in lateral raised areas, surface dulled by reticulotransverse shagreening, apical area impunctate or with minute punctures no broader than base of hairs arising from them, separated by two to four puncture widths, surface moderately shiny, with fine reticulotransverse shagreening; terga 3 and 4 similar to tergum 2 but punctures of interband zone somewhat more distinct and more abundant and apical zone smaller or absent; pygidial plate broadly V-shaped with rounded apex.

Hair: On face and genal areas pale ochraceous to yellow, on vertex yellow to bright rufescent, vertex with or without brown hairs (never abundant). Thorax with sides pale ochraceous to pale rufescent, above ochraceous to bright rufescent. Metasomal tergum 1 with long basal and lateral hairs ochraceous to yellow or slightly rufescent, apical area glabrous or with sparse, minute, appressed, brown to yellow hairs basally and laterally; tergum 2 with basal pubescence long, white to yellow, interband zone with short; appressed to subappressed, white to pale brown, relatively simple hairs, distal pale band yellow to white, broad laterally (but usually not reaching apical margin) to narrow medially, usually narrowly interrupted medially, apical area with relatively simple, appressed to subappressed, white to yellow hairs obscuring but not completely hiding surface; tergum 3 similar to 2 but basal tomentum dark brown, interband zone hairs dark brown, distal pale band not interrupted, apical area shorter; tergum 4 similar to 3 but distal pale band reaches apex across entire tergum, occasionally with minute apicomедial area of brown hairs; terga 5 and 6 dark brown except white to yellow tufts at extreme sides; sterna yellow to reddish brown medially and paler at extreme sides. Legs pale (white to yellow) except as follows: fore tarsi, often middle basitarsi on outer surfaces, fore and middle tibiae on outer surfaces near apices, hind basitarsi on outer surface at apices, and usually on and surrounding basitibial plates brown; inner surfaces of hind basitarsi with red to reddish brown hairs; scopal hairs ochraceous to yellow.

*Male.* Measurements and ratios: N, 20; length 9-12 mm.; width, 3.0-4.0 mm.; wing length,  $M = 3.20 \pm 0.217$  mm.; hooks in



hamulus,  $M = 11.65 \pm 0.274$ ; flagellar segment 2/segment 1,  $M = 7.37 \pm 0.164$ .

Structure and color: Integument black except as follows: clypeus and base of mandible yellow; labrum white or cream-colored with brown apical margin (extremely rarely all brown); eyes green to gray or grayish blue; flagellum yellow to red below, dark red to brown above; tegulae usually testaceous, occasionally piceous; wing membranes colorless, veins yellow; apical margins of terga hyaline, colorless to yellow (in some eastern specimens translucent brown); distitarsi rufescent; tibial spurs white to yellow.

Clypeus protruding beyond eye in profile by about half width of eye; eyes strongly converging toward mandibles; first flagellar segment with minimum length equal to about one-sixth or one-seventh maximum length of second segment, penultimate segment about three times as long as broad (minimum width, maximum length), flagellar segments without longitudinal lateral depressions; maxillary palpal segments in ratio of about 4:3:3:1. Sculpturing as in female except as follows: clypeus with surface often moderately shiny; mesepisternum with surface often somewhat dulled by fine, irregular shagreening; metasomal tergum 1 medially with basal four-fifths to five-sixths with small punctures separated by one to three puncture widths; interband zone of terga 2 and 3 with slightly more abundant and larger punctures, surface moderately shiny, with reticular shagreening; hyaline apical areas of terga 1 to 5 shiny or moderately so, reticulotransverse shagreening extremely fine; sterna with surfaces shiny to moderately so, usually with distinct regular reticular shagreening.

Sternum 7 with median plate subtriangular in shape; larger than lateral plate in area, with abundant short hairs ventrally; lateral plate subtriangular; membranous area between plates almost half size of lateral plate in area, narrow; apicomedial margin between median plates with strong curved carinae on each side. Sternum 8 broad near apex; strongly emarginate apicomediaally; with ventral tubercle entire or slightly bidentate, not reaching apical margin of sternum; with several to many hairs on apical margin. Gonostylus slender, tapering apically, not distinctly capitate, in length equal to more than half length of gonocoxite, with abundant short hairs laterally on basal half; spatha about three times as broad as long; gonocoxite with spicules of upper inner surface all or mostly pointed or hairlike; penis valve with prominent dorsolateral lamella which ends proximally in an inflected tooth near spatha (Figs. 72-75).

Hair: Color of vestiture as in female except as follows: generally more males appear pale rather than bright rufescent than females; vertex usually without brown; metasomal tergum 1 with basal four-fifths to five-sixths with long pale hairs and these medially at least long enough to reach apical margin although not abundant enough to completely hide apical area; tergum 2 with distal pale band often not interrupted medially, usually as long as or longer than apical area medially, interband zone usually with abundant long pale suberect hairs; terga 3-5 similar to 2 but basal zone tomentum brown, interband zones usually with scattered pale pubescence as well as suberect hairs and distal pale bands progressively closer to apical margin; terga 6 and 7 with long white to ochraceous or yellow hairs; sterna all pale or yellowish medially; legs white or ochraceous except as follows: inner surfaces of basitarsi and usually distitarsi yellow to reddish yellow.

*Geographical Variation.* *Melissodes agilis* is distributed throughout the United States (except Florida), southern Canada and northern Mexico (Fig. 9). It is remarkably uniform throughout this range; the chief variations being the degree of brightness of the yellow or red vestiture and in size. In neither of these characteristics is there a marked geographical trend. However, male specimens from eastern parts of the range tend to have the apical hyaline margins of the metasomal terga darker in color than specimens from elsewhere in the range. Also, specimens, especially females, from the northern prairie states and from the southcentral and southwestern provinces of Canada tend to have the vestiture paler or duller in color than elsewhere. In neither of these two cases is there an abrupt step in the clines which must exist and it would be difficult, if not impossible, to delimit clear-cut subspecies.

*Bionomics.* Very little has been published concerning the nesting habits of *Melissodes agilis*. Rau (1922, p. 34) states that *agilis* was found nesting on a baseball diamond on July 24, 1915. A single female had begun a single burrow. No cells or provisions were yet present. The burrow ". . ." was five inches deep, and went downward quite precipitously." A second female was observed by Rau on August 22, 1915 at its horizontal burrow in the face of a clay bank. Custer (1928) reports a female which was possibly *M. agilis* using the same burrow entrance as eight females of *Svastra obliqua* (Say) (see LeBerge, 1956, pp. 974, 975).

*M. agilis* is apparently an oligolege of the composite genus *Heli-anthus*. Robertson (1926, p. 379) lists this species as oligolectic

on the composite tribes Astereae and Heliantheae. Out of almost 6,000 bees available to the author for study, a total of 2,135 had floral data attached. Out of these 2,135 bees, 1,909 had been taken on some species of the family Compositae and, more specifically, 1,608 had been taken on some species of *Helianthus*. These data are summarized in Table IV. It is evident that *Helianthus* pollen plays an overwhelmingly important role in the nutrition of this species. Of other pollens only the Compositae are of much importance and no single genus (or even tribe) of the Compositae plays nearly as important a role as does *Helianthus*.

TABLE IV. Summary of Floral Records for *Melissodes agilis*.

Plant Data			Records of <i>M. agilis</i>			
FAMILY	Number of genera	Approximate number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae (other than <i>Helianthus</i> )	35	43	144	63	255	318
<i>Helianthus</i> spp.	1	15	450	423	1,193	1,621
Leguminosae	5	7	32	13	56	69
Brassicaceae	3	4	21	7	50	57
Verbenaceae	1	1	9	1	43	4
Labiatae	2	2	3	2	11	13
Hydrophyllaceae	2	2	3	2	1	3
Others (12)	15	15	18	4	36	40
Totals	64	89	670	520	1,645	2,165

*Type Material.* The lectotype male of *agilis* (No. 2315) with two male paratypes from Texas are in the collection of the Philadelphia Academy of Sciences. The lectotype female of *aurigenia* (No. 2332) and allotype male (No. 2332.2) both from Colorado are in the collection of the Philadelphia Academy of Sciences. The paratypes of *aurigenia* also in the Philadelphia Academy of Sciences collection include three females from Colorado, Louisiana and Canada, respectively, and five males from New York, Virginia, Kansas and Utah. Two female paratypes (Nos. 2332.3 and 2332.5) are not of



the same species but should be referred to *Melissodes perlusa* Cockerell which is redescribed below.

*Distribution.* The United States (except Florida), southern Canada and northern Mexico (Fig. 9). This species has been collected from April until mid-November, but chiefly during the months of July, August and September. In addition to the type specimens, females and males have been examined from the localities listed below (localities reported in the literature are included).

ALABAMA: Decatur; Mobile. ARIZONA: Arlington; Carr Canyon (Huachuca Mts.); Chambers; Douglas (and 8 miles N. E.); Flagstaff (and 4 miles N., 7 miles S. and 8 miles N. E.); Fredonia; Grand Canyon; Hereford; Mayer; Mesa (6 miles E.); Nogales; Oak Creek Canyon; Palmerlea; Payson; Phoenix; Prescott; Rosemont; San Francisco Mts.; Sedona (15 miles N.); Show Low; Sonoita (10 miles E. and 11 miles W.); Thatcher; Tucson (and 10 miles S.); Turner; Willcox; Williams; Yuma. CALIFORNIA: Altadena; Altamont (Mt. House Creek); Anaheim; Antioch; Arvin; Bakersfield; Bear Valley; Bishop; Canby; Carbona; Catalina Island; Chino; Claremont; Clear Lake (Soda Bay); Clovis; Coalinga; Colton; Corona; Corral Hollow; Costa Mesa; Davis; Dos Palos; Downey; East Highlands; Exchequer; Firebaugh; Fresno; Hemet; Hueneme; Huntington Beach; Huntington Park; Indio; Kingsburg; Lake City; Lake Tahoe; Lancaster; Lemoore; Lone Pine; Los Angeles; Los Banos (5 miles S.); Mira Loma; Modesto; Monrovia Canyon; Mountain View; Oakley; Ontario; Onyx; Orange; Oxalis; Palm Springs; Pasadena; Patterson; Pleasanton; Redlands; Redwood City; Reseda; Riverside; Rock Creek; Sacramento; Sacramento Co.; San Bernardino Co.; San Jacinto; San Jose; Shafter; Torrance; Tracy; Turlock; Twain Harte; Vernalis; Visalia; Walnut Creek, Contra Costa Co.; Wasco; Westley; Whittier; Wood Lake, Tulare Co.; Woodland Hills. COLORADO: Antonito; Aurora; Baca Co.; Berkley; Boulder; Brighton; Buckeye; Canfield; Carson Camp; Cimarron; Clear Creek; Colorado Springs; Cortez; Crowley; Denver; Dixon Canyon; Durango; Eads; Elbert; Fort Collins; Fruita; Gilpin (Lump Gulch) Co.; Glen Haven; Glen Park; Glenwood Springs; Golden; Golden (Chimney Gulch); Goodview; Grand Junction; Great Sand Dunes, Alamosa Co.; Greeley; Trinidad; Jim Creek (near Boulder); Jumbo Reservoir; La Junta; Lamar; Leadville; Logan Co.; Longmont; Maxwell City; Meeker; Mesa Verde; Midway (5 miles N.); Mt. Manitou, El Paso Co.; Ovid (3 miles E.); Palisade; Pingree Park; Platte Canyon; Poudre Canyon; Pueblo; Rifle Gap; Rock Creek; Rocky Ford;

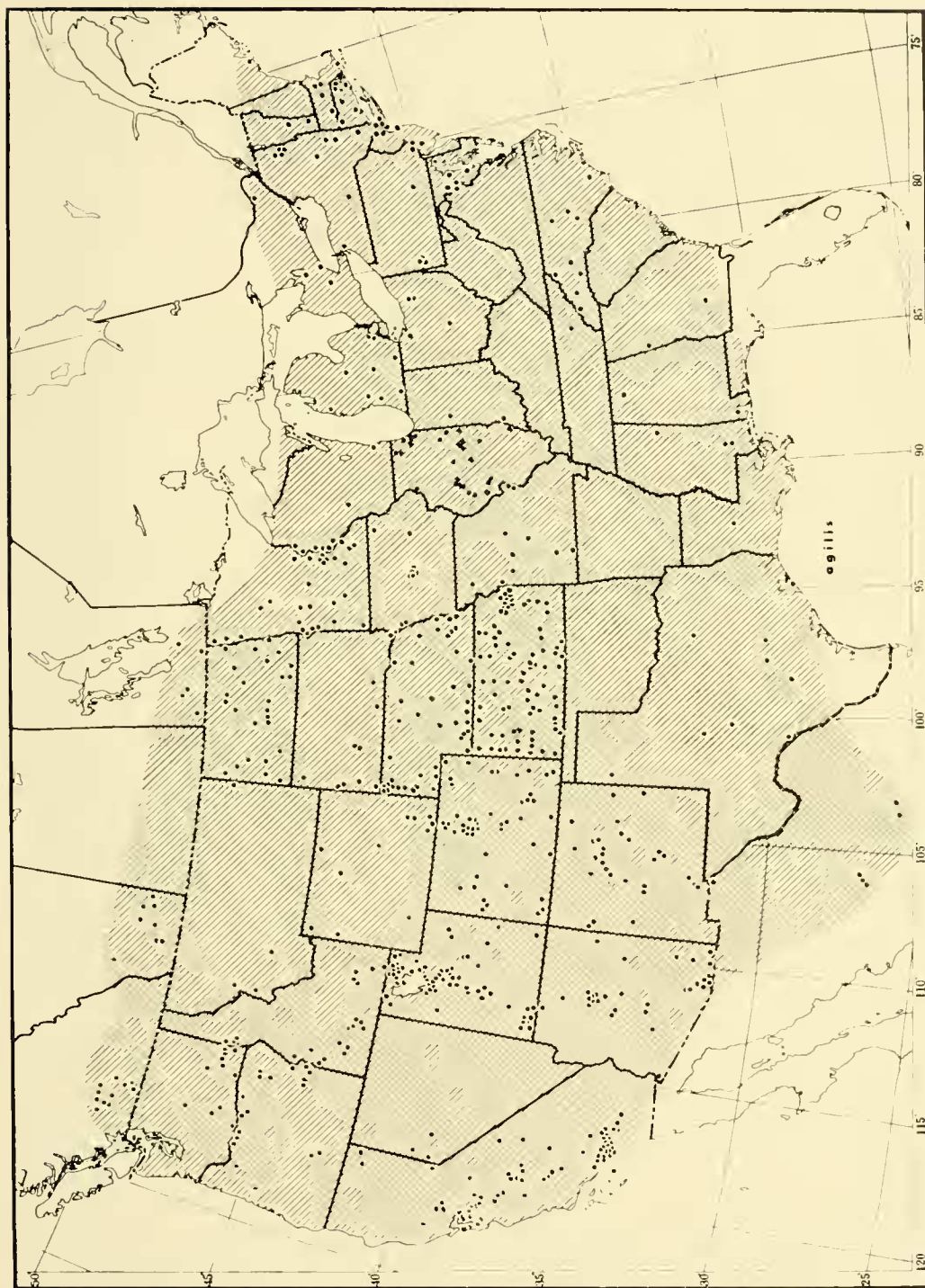


FIG. 9. Map showing the known distribution of *M. (Eumelissodes) agilis* Cresson.

Springfield (3 miles N. in Lone Rock Draw); Sterling; Stratton; Stratton (Landaman Creek); Ten-sheep Ranch; Timpas; Ute Creek (Sage Flats); White Rock (near Boulder); Wray. CONNECTICUT: Colebrook; Storrs; Wallingford; Westville. DISTRICT OF COLUMBIA: Bennings (Eastern Branch); Washington. GEORGIA: Carrollton; Tifton. IDAHO: Aberdeen (and 2 and 6 miles N. E.); Bliss; Brunneau; Buhl; Central Grade, Nez Perce Co.; Coyote Grade, Nez Perce Co.; Downey; Emmett (10 miles E. on Squaw Creek); Fort Hall (near Blackfoot); Franklin; Grandview; Jerome; Lewiston; Midvale (9 miles S. W.); Moscow; Mountain Home; Nampa; Parma; Tuttle; Twin Falls. ILLINOIS: Algonquin; Ashkeum; Bath; Beardstown; Beverly Hills; Bloomington; Carlinville; Champaign Co.; Charleston; Chicago; Cook Co.; Danville; Decatur; Devil's Neck (10 miles N. of Havana); Downers Grove; Edgebrook; Evanston; Fulton (3 miles S.); Havana; Hillview; Macoupin Co.; Manitou; McHenry; Meredosia; Mt. Carmel; Oak Park; Seymour; Urbana; Wellington. INDIANA: LaFayette; Vincennes. IOWA: Ames; Boone (4 miles N. W., 1 mile E. and 5 miles S. E.); Decorah; Ledges State Park; Montpelier; Sargent Bluffs; Sioux City; Vinton. KANSAS: Allen Co.; Anderson Co.; Arkansas City; Assaria; Baldwin; Baldwin Junction; Blue Rapids; Burdett; Butler Co.; Caldwell; Chase (5 miles W.); Cheyenne Co.; Clark Co.; Clay Co.; Cloud Co.; Coldwater; Cullison; Decatur Co.; De Soto; Dickinson Co.; Dodge City; Douglas Co.; Edwards Co.; Garden City; Garnett; Great Bend; Harper Co.; Harvey Co.; Hays; Hodgeman Co.; Hoffee; Hutchinson; Jetmore (10 miles S.); Johnson (2 miles N.); Kendall (3 miles E.); Kingman; Kismet; Lake View, Douglas Co.; Lakin; Larned; Lawrence; Liberal; Logan Co.; Lone Star Lake, Douglas Co.; Manhattan; Marysville; Mayfield; Meade; Meade Co. St. Park; Medora; Neosho Co.; Nickerson; North Topeka; Norton Co.; Olathe; Osborne Co.; Pottawatomie Co.; Reece; Reno; Republic Co.; Richfield (7 miles S.); Riley Co.; Rooks Co.; Russell Co.; Saline Co.; Scott City (8 miles N.); Scott Co.; Sharon Springs; Sherman Co.; Smith Co.; Sunflower; Syracuse; Thomas Co.; Topeka; Tribune (10 miles E.); WaKeeney; Wallace Co.; Wellington; Wichita; Wichita Co.; Wilson Co. LOUISIANA: "La." MAINE: Waldoboro. MARYLAND: Cabin John; Chesapeake Beach; Jessups; Lakeland; Plummerville Island. MASSACHUSETTS: Chicopee; Forest Hills; Holden; Lexington; Wellesley; Woods Hole. MICHIGAN: Allegan Co.; Constantine; East Lansing; Grand Rapids; Lewawee Co.; Macomb Co.; Manistee Co.; Midland Co.; Utica. MINNESOTA: Alexandria; Big Stone Co.; Browns Val-



ley; Evan; Faribault; Grant Co.; Hallock; Hastings; Itasca State Park; Lake City; Lake Vadnais, Ramsey Co.; Mallory; Marshall Co.; Mound Springs State Park, Rock Co.; Muskoda; North Branch; Olmstead Co.; Ortonville; Park Rapids; Pine Co.; Powder Plant Woods, Ramsey Co.; Renville; Rochester; Sedan; St. Anthony Park; St. Cloud; St. Paul; Traverse Co.; Washington Co.; Yellow Medicine Co. MISSISSIPPI: Camp Shelby (near Hattiesburg); Hattiesburg; West Point. MISSOURI: Branson; Cameron (10 miles N.); Columbia; Holden; Kansas City; Ozark Lake; Sedalia; Shrewsbury; Springfield; St. Louis. MONTANA: Fairview; Hamilton; Missoula; Whitehall. NEBRASKA: Agate; Bennet; Bloomington; Bridgeport; Broken Bow; Cambridge; Cedar Bluffs; Collins; Crawford; Fairmont; Gerding; Glen; Gordon; Haigler; Halsey; Hamlet; Hardy; Harrison; Hitchcock Co.; Jim Creek, Sioux Co.; Kearney; Kimball; Lincoln; Lodgepole; Long Pine; Malcolm; Maywood; McCook; Mitchell; Monroe Canyon, Sioux Co.; Nebraska City; Neligh, Niobrara; North Platte; Omaha; Oxford; Palisade; Pine Ridge; Sidney; Sioux Co.; Union; Valentine (Valentine Lakes Refuge); Wabash; Warbonnet Canyon, Sioux Co.; West Point. NEVADA: Fallon; Pyramid Lake, Washoe Co.; Reno. NEW HAMPSHIRE: Hanover. NEW JERSEY: Gloucester Co.; Monmouth Beach; Orange; Palmyra; Ramsey; Snake Hill. NEW MEXICO: Albuquerque; Alto; Belen; Capitan; Carrizozo; Cuervo; Fort Wingate; Gallup; Jemez Springs; Las Cruces; Las Vegas; Madrid; Magdalena Mts.; Maxwell; Mesilla; Omega; Organ Mts.; Portales; Rio de los Frijoles; Romeroville; Rowe; Sandia Mts.; San Ignacio; San Jon; Santa Fe (and 12 miles S. E.); Sapello; Socorro; Taos; Vaughn. NEW YORK: Albany; Astoria (Long Island); Bronx Park; Brooklyn; Buffalo; Central Park; Elizabethtown; Gloversville; Great Kills (Staten Island); Hope; Ithaca; Keene Valley, Essex Co.; New Baltimore; New Rochelle; New Russia; Orient; Pelham; Wilmington. NORTH CAROLINA: Aberdeen; Biltmore; Boone; Bostic; Burgaw; Burlington; Newton; Sanford; Smokemont. NORTH DAKOTA: Bismarck; Clifford; Dickinson; Drake; Edgeley; Fargo; Grafton (4 miles E.); Lakota; Mandan; Marmarth; McKenzie; Medora; Monango; Mott; New Rockford; Oakdale; Oakes; Pleasant Lake; Rugby; Schafer; Sheldon; Steele; Valley City; Washburn; Williston. OHIO: Barberton; Columbus; Summit Co.; Tiffin. OREGON: Arlington; Corvallis; Cove; Echo; Hood River; Huntington; Ione; Juntura (6 and 8 miles E.); La Grande; North Powder; Ontario; Oregon City; Silver Lake; Summer Lake; The Dalles (and 14 miles E.); Vale (Malheur River Canyon). PENNSYLVANIA: Allegheny Co.; Harrisburg; North Braddock; Philadelphia; Pittsburg.

RHODE ISLAND: Kingston; Providence; Scituate. SOUTH DAKOTA: Ardmore; Buffalo (3 miles S.); Cedar Pass (Badlands); Clearfield; Custer; Deadwood (and 10 miles S.); Elk Point; Interior (White River); Jefferson (3 miles S.); Platte. TENNESSEE: Knoxville. TEXAS: Adrian; Austin; Bexar Co.; Colorado City; Dallas; Del Rio; Fedor, Lee Co.; Galveston; San Angelo. UTAH: Avan Canyon; Bear Lake; Bert; Big Cottonwood Canyon (Wasatch Mts. near Fort Bench); Bluff; Bountiful; Cache Junction; Cache Valley; Clover; Collinston; Corinne; Curlew; Delta; Deweyville; Dugway Proving Ground, Tooele Co.; Erda; Eureka; Far West; Ferron; Fillmore; Fort Duchesne; Garfield; Goshen; Grantsville; Green River; Hatton; Helper; Hurricane; Hyrum; Indianola; Jericho; Johnson's Pass, Tooele Co.; Kaibab Forest; Kelton; Lampo; Lake Point; Lake-town; Lehi; Lincoln; Logan; Logan Canyon; Magna; Moab; Morgan; Mt. Carmel; Mt. Zion National Forest; Myton; Nephi; Oak City; Ogden; Paragonah; Park Valley; Parowan; Penrose; Petersboro; Pintura; Plain City; Pleasantview; Price; Promontory; Providence; Provo; Richfield; River Heights; Rockville; Roosevelt; Rozelle; Salt Lake City; Saltair; Sevier; Silver City; Skull Valley; Smithfield; Spanish Fork Canyon; Springville; Thistle; Timpie; Tooele; Topaz; Utah Lake; Valley City Junction; Washakie; West Utah Lake; Zion National Park.\* VERMONT: Townshend; Woodstock. VIRGINIA: Camp Peary; Falls Church; Four-mile Run (Near mouth of). WASHINGTON: Clarkston; Lind; Maryhill; Penawawa; Pullman, Riparia; Sunnyside; Walla Walla; Wawawai; Wenatchee; Yakima. WISCONSIN: East Farmington; Hudson; Maiden Rock; Milwaukee; Prescott; Randall, Burnett Co.; Warrens; Yellow River (mouth of), Burnett Co. WYOMING: Casper; Cheyenne; Clifton; Diamond Ranch, Platte Co.; Flat Creek; Grand Teton National Park; Granite Canyon, Laramie Co.; Green River; Laramie (28 miles E.); Sheridan; Wheatland (N. Fork of Green River); Worland; Yellowstone National Park. *Canada.* ALBERTA: Calgary; Lethbridge; Medicine Hat; Morrin; Scandia; Suffield; Taber (Oldman River); Welling; Whitla. BRITISH COLUMBIA: Ashcroft Manor (3 miles W.); Fairview; Kamloops; Keremeos; Lillooet; Nicola; Okanagan Falls; Oliver; Spencers Bridge (15 miles E.); Summerland; Thompson River; Vernon; Wallhackin. MANITOBA: Altona; Aweme; Brandon; Lauder; Treesbank. NORTHWEST TERRITORY: "N. W. T." (misabeled or misinterpreted?). ONTARIO: Guelph; Ottawa; Stroud; Toronto. *México.* CHIHUAHUA: Allende; Jiménez (10 and 17 miles W.); Ciudad Juarez; Saláices. COAHUILA: San Pedro de Colonias. DURANGO: Torreón.

*Flower Records.* In this list are included flower records reported in the literature. *Abutilon theophrasti*, *Althaea rosea*, *Aplopappus spinulosus*, *Arctium* sp., *Argemone* sp., *A. platyceras*, *Bidens aristosa*, *B. laevis*, *Blephilia hirsuta*, *Brassica juncea*, *Brauneria pallida*, *Carduus crispus*, *Carya pecan*, *Cassia* sp., *C. chamaecrista*, *C. fasciculata*, *Centromadia pungens*, *Chrysopsis hispidus*, *Chrysanthamnus* sp., *Cirsium* sp., *C. altissimum*, *C. discolor*, *C. lanceolatum*, *C. undulatum*, *Clematis* sp., *Cleome* sp., *C. lutea*, *C. serrulata*, *Convolvulus* sp., *Coreopsis* sp., *C. lanceolata*, *C. palmata*, *C. tripteris*, *Cosmos* sp., *Datura metaloides*, *Enceliopsis* sp., *Engelmannia pinnatifida*, *Ericameria palmeri*, *Eupatorium* sp., *E. purpureum*, *Eustoma artemifolium*, *Gaillardia* sp., *G. cristata*, *Gilia* sp., *Grindelia* sp., *G. squarrosa*, *Gutierrezia* sp., *G. sarothrae*, *Haplopappus* sp., *Helenium autumnale*, *H. laciniatum*, *Helianthus* sp., *H. annuus*, *H. atrorubens*, *H. bolanderi*, *H. ciliaris*, *H. coronarius*, *H. divaricatus*, *H. grosse-serratus*, *H. laetiflorus*, *H. lenticularis*, *H. maximillianus*, *H. mollis*, *H. petiolaris*, *H. pumulis*, *H. radulus*, *H. rigidus*, *H. salicifolius*, *H. scaberrius*, *H. subrhomboides*, *H. tuberosus*, *Heliopsis* sp., *Heliotropium* sp., *Hibiscus* sp., *Ipomoea* sp., *Lactuca pulchella*, *Lepachys pinnata*, *Liatris pycnostachya*, *Medicago sativa*, *Melilotus* sp., *M. alba*, *Mentha canadensis*, *Monarda fistulosa*, *Penstemon* sp., *Pepo* sp., *Petalostemum* sp., *P. occidentale*, *P. purpureum*, *Phacelia* sp., *Physostegia* sp., *P. parviflora*, *Platycodon grandiflorum*, *Pluchea camphorata*, *Prionopsis* sp., *Pycnanthemum flexuosum*, *P. pilosum*, *Pyrhopappus multicaulis*, *Rudbeckia hirta*, *R. laciniata*, *R. triloba*, *Schrankia uncinata*, *Senecio* sp., *Silphium* sp., *S. integrifolium*, *S. laciniatum*, *S. perfoliatum*, *S. speciosum*, *Sium cicutaefolium*, *Solidago* sp., *S. canadensis*, *S. serotina*, *S. trinervata*, *Teucrium canadense*, *Verbena* sp., *V. hastata*, *V. stricta*, *Verbesina* sp., *V. encelioides*, *V. exauriculata*, *V. occidentalis*, *Vernonia* sp., *V. baldwini interior*, *V. fasciculata*, *Veronica* sp., *Vitex agnus-castus*, *Wislizenia refracta*.

*Melissodes (Eumelissodes) trinodis* Robertson

*Melissodes trinodis* Robertson, 1901, Canadian Ent., vol. 33, p. 231; 1905, Trans. Amer. Ent. Soc., vol. 31, p. 369; Graenicher, 1905, Bull. Wisconsin Nat. Hist. Soc., vol. 3, p. 164-165; 1911, Bull. Pub. Mus. Milwaukee, vol. 1, p. 247; Smith, 1910, Ann. Rept. New Jersey State Museum, p. 693; Robertson, 1914, Ent. News, vol. 25, p. 70; 1926, Psyche, vol. 33, p. 119; 1928, Flowers and Insects, p. 8; Pearson, 1933, Ecol. Monogr., vol. 3, p. 381; Graenicher, 1935, Ann. Ent. Soc. Amer., vol. 28, p. 304; Brimley, 1938, Insects of North Carolina, p. 463.

*Melissodes pennsylvanica*, Robertson, 1897, Trans. Acad. Sci. St. Louis, vol. 7, p. 355 (misidentification).

This species is closely related to *M. agilis*. The female of *trinodis* is very similar to that of *agilis*, differing chiefly in the darker color



as described below. The male can be separated from that of *agilis* by the piceous tergal margins, the black mandibular bases, the darker wing veins and the often less densely shagreened galeae.

*Female.* Measurements and ratios: N, 20; length, 10-12 mm.; width, 3.5-4.0 mm.; wing length,  $M = 3.45 \pm 0.094$  mm.; hooks in hamulus,  $M = 12.50 \pm 0.224$ ; flagellar segment 1/segment 2,  $M = 1.79 \pm 0.023$ .

Structure and color: Integument black except as follows: apical half of mandible, distitarsus usually and flagellar segments 3 to 10 below rufescent; tegulae testaceous to piceous; eyes yellow to dark gray; wing membranes hyaline, veins dark reddish brown to black; tibial spurs yellow.

With structural characteristics of *agilis* except as follows: clypeus protruding beyond eye in profile usually by less than half width of eye, punctures round, regular, separated mostly by about half a puncture width; vertex with flattened lateral areas usually moderately shiny; maxillary palpal ratio about 4.25:3.50:3.75:1.00; galeae finely tessellate above; mesoscutum with punctures separated mostly by half a puncture width or less (including posteromedian area); mesepisternal punctures usually extremely shallow, surface dulled by fine, irregular shagreening; metasomal tergum 2 with interband zone punctures shallow, small, often absent at least; medially, separated mostly by more than one puncture width.

Hair: Color of vestiture as in *agilis* except as follows: labrum and apical half of clypeus often reddish brown; vertex usually with abundant dark brown hairs (occasionally all pale); head and thorax bright rufescent (rarely ochraceous); mesoscutum rarely with a few brown hairs in posteromedian area and scutellum occasionally with brown hairs medially; metasomal tergum 2 with interband zone hairs subappressed to erect, dark brown, apical area with short, appressed, relatively simple, dark brown hairs, distal pale band white and interrupted medially; tergum 3 with apical area as in tergum 2, distal pale band white and narrowly to broadly interrupted medially, rarely distal pubescent band all brown; tergum 4 brown at least in small apicomedian patch, often across all or most of apical margin of tergum and often interrupting distal pale band medially, occasionally tergum 4 all brown; terga 5 and 6 usually with pale lateral tufts but in darkest specimens all brown; sterna brown to dark brown except pale at extreme sides. Legs with hairs dark brown except as follows: femora yellow to rufescent; fore and middle tibiae and middle basitarsi often pale basally on outer

surfaces; tibiae with inner surfaces yellow to red; middle and hind basitarsi with inner surfaces dark red to brown; scopal hairs ochraceous to yellow except usually brown on and surrounding basitibial plates and near apices of basitarsi.

*Male.* Measurements and ratios: N, 20; length, 10-11 mm.; width, 3.5-4.0 mm.; wing length,  $M = 3.24 \pm 0.152$  mm.; hooks in hamulus,  $M = 11.25 \pm 0.054$ ; flagellar segment 2/segment 1,  $M = 9.06 \pm 0.156$ .

Structure and color: Integument black except as follows: labrum with large mediobasal cream-colored macula; mandible rarely with small basal yellow macula; clypeus yellow; flagellar segments 2-11 red beneath, brown above; eyes green to yellowish brown or gray; wing membranes hyaline, colorless or slightly milky, veins reddish brown to black; tegulae usually piceous, occasionally testaceous; tarsi rufescent; tibial spurs white to yellow; apical margins of terga piceous to dark brown.

Structure as in *agilis* with the following differences: clypeus protruding beyond eye in profile by slightly less than half width of eye; minimum length of first flagellar segment equals one-seventh or less (often less than one-eighth) of maximum length of second segment; maxillary palpal ratio about 8:7:6:1. Sculpturing as in female except as follows: galeae above usually finely tessellate in apical half, often slightly so posteriorly, occasionally shiny except at tips; mesoscutal punctures often separated by more than half but less than one puncture width in posteromedian area; mesepisterna punctures usually deep, surface shiny to somewhat dulled by irregular shagreening; metasomal tergum 1 with basal five-sixths (medially) punctate, punctures smaller and sparser apically, in basal half separated mostly by half to one puncture width; tergum 2 with interband punctures distinct, separated by one to two puncture widths, apical area without distinct punctures; terga 3-5 similar to tergum 2 but interband punctures more regular in size, more crowded and smaller.

Sternum 7 similar to *agilis* but with median plate subtriangular, subequal or slightly larger than lateral plate in area, with ventral hairs minute. Sternum 8 as in *agilis* but ventral tubercle low, rounded, entire, with several short weak hairs at apex on either side of median emargination. Genital capsule as in *agilis* except as follows: gonostylus slender, indistinctly capitate, equal to about half length of gonocoxite, with short hairs laterally and minute hairs on inner surface (Figs. 76-77).

**Hair:** Color of vestiture as in female except as follows: without brown on clypeus, labrum or vertex; mesoscutum and scutellum without brown; terga 2-4 with apical areas with suberect brown hairs (often absent due to wear), distal pale bands usually complete but occasionally interrupted medially at least on tergum 4; tergum 5 often with a complete distal pale band, occasionally absent or broadly interrupted medially; terga 6 and 7 brown to almost black; sterna rufescent or golden medially and ochraceous to white laterally; legs with ochraceous hairs except inner surfaces of tarsi and hind tibiae yellowish. Thoracic and head hairs usually bright rufescent above and somewhat duller at sides, occasionally all thoracic and head hairs dull ochraceous.

*Remarks.* This bee resembles *M. agilis* very closely, especially in the female sex. It is quite possible that some paler females of *trinodis* have been identified as *agilis* or vice versa. That *trinodis* might be merely a variant of *agilis* appearing sporadically has been seriously considered. This hypothesis has been rejected on the basis that the males of *agilis* and *trinodis* are quite distinct and because *trinodis* does not appear west of the Great Plains where *agilis* is very abundant.

There is no uniform geographical variation in *trinodis* which could serve for the recognition of subspecies. However, females from the eastern seaboard, particularly from North Carolina, tend to be much darker in color than elsewhere in the range of the species. Some few females from this area resemble the females of *dentiventris* Smith and *bidentis* Cockerell (see below) on this account.

*Bionomics.* The only observations on the nesting habits of this species were published by Graenicher (1905, pp. 164-165). Graenicher briefly describes the nest of *M. trinodis* in connection with his studies of bee parasites and, in particular, in connection with the bee *Triepeolus helianthi* Robertson which was found parasitizing *M. trinodis*. Graenicher states, ". . . a ground inhabiting bee digs down perpendicularly to a depth of 8 cm., then turns off obliquely for a short distance, and continues in a perpendicular direction. The cells are somewhat thimble-shaped, their walls are formed of hardened clay with a very smooth and polished inner surface. They are filled about one-half with bee-bread." Graenicher observed *Triepeolus helianthi* entering the *M. trinodis* nest and he opened the nest on the following day. He observed two cells, one unfinished, the other closed and showing a white, opaque



egg of the host, 3 mm. in length, on the surface of the bee-bread. Graenicher then describes the activities of the first and second stage larvae of *T. helianthi* and, although he later dug up an additional nest of *M. trinodis*, he records no additional observations on this bee.

In regard to flower preferences, Robertson (1926) regarded *M. trinodis* as an oligolege of *Aster*, *Heliantheae* and *Heleniae*. This is very nearly correct, although the data available to the present author suggests that the genus *Aster* and the tribe *Heleniae* are not preferred markedly more than many other composites which these bees visit. On the other hand, the tribe *Heliantheae*, and particularly the genus *Helianthus*, is of the greatest importance as a source of pollen. The bee would be better described as an oligolege of the *Compositae* and in particular of *Helianthus*. The data supporting these conclusions is summarized in Table V.

TABLE V. Summary of Floral Records for *Melissodes trinodis*.

Plant Data			Records of <i>M. trinodis</i>			
FAMILY	Number of genera	Number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae, other than <i>Helianthus</i>	9	15	28	13	88	101
Compositae, <i>Helianthus</i> spp.	1	6	34	30	26	56
Others (6)	6	6	7	4	5	9
Totals	16	27	69	47	119	166

*Type Material.* Lectotype female (Robertson No. 9513) collected on *Helianthus grosse-serratus*, September 20, 1890 by Charles Robertson at Carlinville, Illinois, and lectoallotype male (Robertson, 8197) taken on *Lepachys pinnata*, July 25, 1888 by Charles Robertson at Carlinville are in the collection of the Illinois Natural History Survey, Urbana. In addition nine female and three male paratypes collected by Charles Robertson at Carlinville are in the collections of the Illinois Natural History Survey.

*Distribution.* This species occurs throughout most of eastern United States from Kansas and North Dakota in the west to Maine and Georgia in the east and in southeastern Canada (Fig. 10).

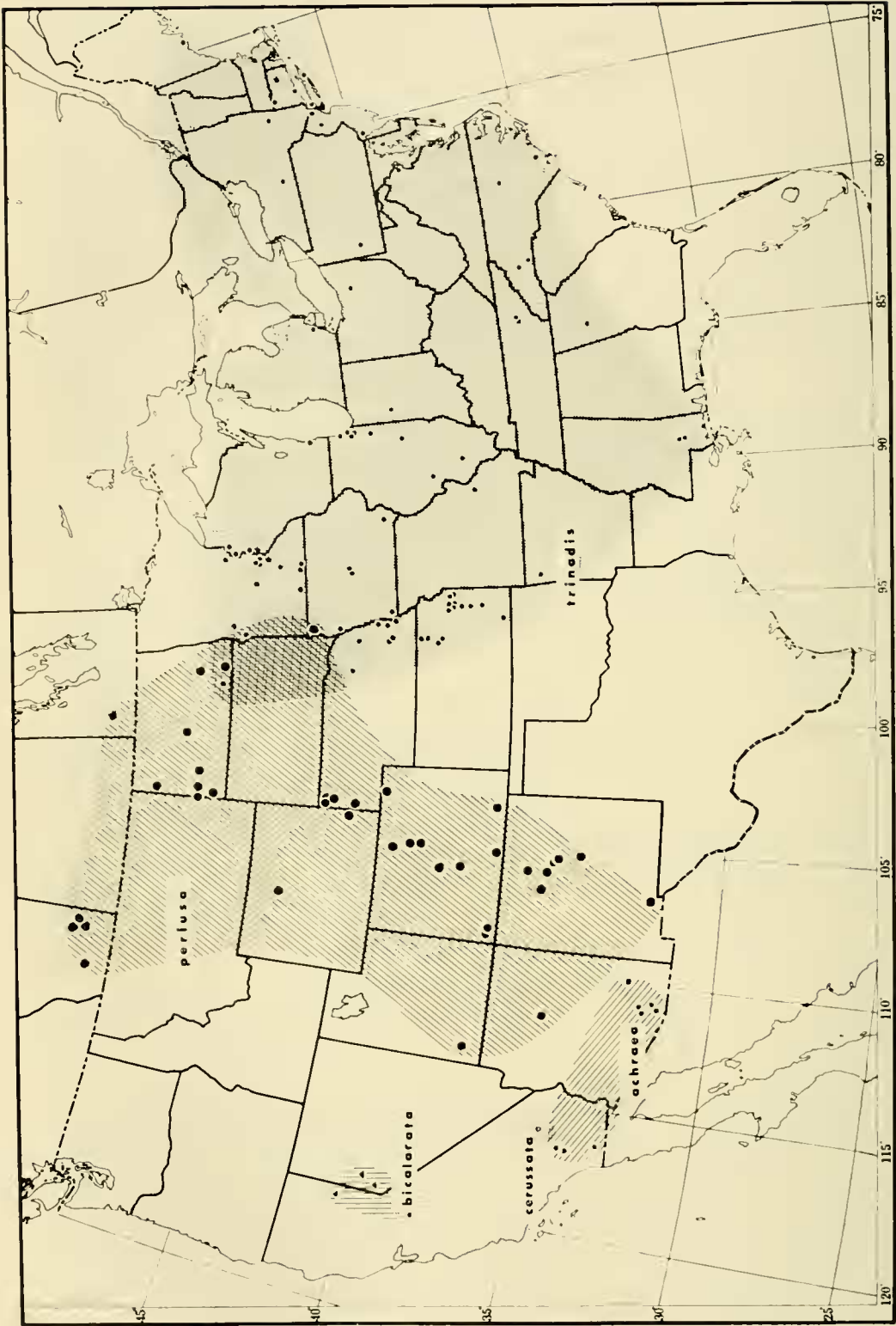


FIG. 10. Map showing the known distributions of *M. (Eumelissodes) trinadis* Robertson, *M. (E.) perlusa* Cockrell, *M. (E.) ochrea* LaBerge, *M. (E.) cerussata* LaBerge, and *M. (E.) bicolorata* LaBerge.

It has been collected between July 7 and October 23, but chiefly during August and September. In addition to the type material, a total of 116 females and 206 males from the localities listed below (including localities reported in the literature) have been examined.

ARKANSAS: Fayetteville. CONNECTICUT: Colebrook; Storrs; Westville (New Haven). GEORGIA: Atlanta. ILLINOIS: Beverly Hills; Carlinville; Chicago; Dubois; Evanston; Kankakee; Palos Park; Urbana; West Pullman; Willow Springs. INDIANA: "Ind." IOWA: Ames (3 miles N. and 6 miles W.); Farragut; Mt. Pleasant (6 miles S. W.); Sioux City. KANSAS: Allen Co.; Baldwin; Baldwin Junction; Blue Rapids; De Soto; Douglas Co.; Franklin Co.; Garnett; Lawrence; Manhattan; Marysville; Montgomery Co.; Olathe; Riley Co. MAINE: Waldoboro. MASSACHUSETTS: Sherborn. MICHIGAN: Detroit. MINNESOTA: Barrett; Big Stone Co.; Dakota Co.; Fairmont; Faribault; Freeborn Co.; Hayward; Howard Lake; Lake Vadnais, Ramsey Co.; Pine Co.; Powder Plant Woods, Ramsey Co.; St. Paul. MISSISSIPPI: Camp Shelby (near Hattiesburg), Hattiesburg. MISSOURI: Silver Spring. NEBRASKA: Lincoln; Louisville; Malcolm; Nebraska City; Neligh; Omaha; West Point. NEW JERSEY: Chester; Ramsey; Salem Co. NEW YORK: Brooklyn; Ithaca; New Rochelle; New Baltimore; Quoque (Long Island). NORTH CAROLINA: Bostic; Burgaw; Marion; Raleigh. NORTH DAKOTA: Monango. OHIO: Barberton. PENNSYLVANIA: Pittsburgh. TENNESSEE: Knox Co.; Knoxville. VIRGINIA: Falls Church. WISCONSIN: East Farmington; Hudson; Milwaukee; Randall; Yellow River (mouth of), Burnett Co.

*Flower Records.* *Arctium* sp., *Asclepias incarnata*, *Aster* sp.; *A. anomalus*, *A. praeatus*, *Bidens aristosa*, *B. laevis*, *Blephilia hirsuta*, *Carduus crispus*, *Cassia chamaecrista*, *Cirsium* sp., *C. lanceolatum*, *Coreopsis palmata*, *C. tripteris*, *Dichophyllum marginatum*, *Grindelia* sp., *Helenium altissimum*, *H. autumnale*, *Helianthus* sp., *H. annuus*, *H. annuus coronarius*, *H. atrorubens*, *H. divaricatus*, *H. grosse-serratus*, *H. maximillianus*, *H. mollis*, *H. salicifolius*, *H. tuberosus*, *Heliopsis helianthoides*, *Lepachys* sp., *L. pinnata*, *Liatris* sp., *Monarda fistulosa*, *Pepo* sp., *Petalostemum purpureum*, *Ratibida columnaris*, *Rudbeckia* sp., *R. hirta*, *R. laciniata*, *R. subtomentosa*, *R. triloba*, *Silphium* sp., *S. integrifolium*, *S. laciniatum*, *S. perfoliatum*, *Solidago* sp., *S. canadensis*, *S. rupestris*, *S. ulmifolia*, *Symphoricarpos* sp., *Teucrium canadense*, *Verbena* sp., *V. hastata*, *V. stricta*, *Vernonia* sp., *V. glauca*, *V. baldwini interior*, *Veronica* sp.



*Melissodes (Eumelissodes) bidentis* Cockerell

*Melissodes bidentis* Cockerell, 1914, Ann. Mag. Nat. Hist., ser. 8, vol. 14, p. 362; Stevens, 1951, Bull. North Dakota Agric. Exp. Sta., No. 14, p. 31.

This small bee is related to both *M. agilis* and *M. trinodis*. It is very similar in color to the darker specimens of *trinodis*. The female of *bidentis* can be distinguished from both *trinodis* and *agilis* by the shiny, unshagreened galeae, and from *agilis* and most specimens of *trinodis* by the lack of pale bands on the abdomen. The male of *bidentis* is similar to that of *trinodis* in having black mandibular bases and dark wing veins, but can be separated from the latter by the longer first flagellar segments and by the unshagreened galeae.

*Female.* Measurements and ratios: N, 20; length, 10-12 mm.; width, 4.0-4.5 mm.; wing length,  $M = 3.36 \pm 0.130$  mm.; hooks in hamulus,  $M = 12.10 \pm 0.216$ ; flagellar segment 1/segment 2,  $M = 1.77 \pm 0.021$ .

Structure and color: Integument black except as follows: apical half of mandible, flagellar segments 3-10 below, distitarsi, occasionally basitarsi, tibiae and femora, rufescent; eyes grayish green; wing membranes slightly infumate, yellowish, veins dark reddish brown to black; tegulae piceous; tibial spurs yellow.

Structure and sculpturing as in *agilis* except as follows: clypeus usually with median carina in apical half; supraclypeal area with small, round, scattered punctures, densely tessellate; galeae shiny, unshagreened except at extreme tips; maxillary palpal ratio about 2.67:2.33:2.67:1.00, last segment sometimes shorter; vertex with lateral flattened areas shiny; mesoscutum with round punctures smaller than in *agilis*, in posteromedian area separated by one to three puncture widths, surface dulled by fine reticular shagreening; scutellum with surface dulled by reticular shagreening; mesepisterna with large, shallow punctures separated by half to one puncture width, surface shiny; metasomal tergum 1 with basal two- to three-fifths with small shallow punctures separated by one to two puncture widths, apical area impunctate, surface dulled by reticulotransverse shagreening; terga 2-4 as in *agilis* but punctures (especially in interband zone) smaller, sparser, and shallower and shagreening coarser.

Hair: Head pale rufescent with abundant dark brown on vertex and labrum and often with clypeus all or partly brown. Thorax above dark ochraceous to bright rufescent, laterally ochraceous to rufescent except dark brown on anterior and lower lateral surfaces

of mesepisterna. Metasoma dark brown to black except as follows: tergum 1 with long ochraceous hairs basally; tergum 2 with basal zone pubescence ochraceous; often some pale hairs on lateral surfaces of terga 2 to 4. Legs dark brown except as follows: inner surfaces of basitarsi and often distitarsi dark reddish brown to black; scopal hairs ochraceous except brown on distal part of basitarsi and on and surrounding basitibial plates.

*Male.* Measurements and ratios: N, 16; length, 10-11 mm.; width, 3.5-4.0 mm.; wing length,  $M = 3.08 \pm 0.135$  mm.; hooks in hamulus,  $M = 10.81 \pm 0.136$ ; flagellar segment 2/segment 1,  $M = 5.21 \pm 0.093$ .

Structure and color: Integumental color as in *trinodis* except as follows: flagellar segment 2 usually dark brown; metasomal terga with apical areas infumate but usually slightly translucent, brown.

Structure as in *trinodis* except as follows: minimum length of first flagellar segment equals one-fifth or more of maximum length of second segment; maxillary palpal ratio about 3:3:2:1. Sculpturing as in female except as follows: supraclypeal area often impunctate but densely tessellate; mesoscutum and scutellum with punctures slightly larger, more crowded, surface moderately shiny, less dulled by shagreening; mesepisterna with punctures deeper; metasomal tergum 1 with basal three- to four-fifths punctate, punctures basally large, distinct, separated by one to three puncture widths; terga 2-5 as in terga 2-4 of female but apical areas impunctate.

Sternum 7 as in *trinodis* but median plate somewhat larger relative to lateral plate. Sternum 8 as in *trinodis* but medioventral tubercle pointed. Gonostylus short, broad, indistinctly capitate, with sparse minute hairs basolaterally; gonocoxites with mediodorsal margins forming a semicircle basad of spatha due to somewhat produced tubercle at margin of each gonocoxite just basad of either end of spatha; spatha just or slightly less than twice as broad as long, without well-defined apicomedial emargination; penis valve narrow, with lateral process short and blunt (Figs. 78-79).

Hair: Head and thorax ochraceous to bright rufescent, usually rufescent above. Metasomal tergum 1 ochraceous basally and laterally to apical margin, apicomediaally with short, suberect, dark brown hairs; tergum 2 with basal pubescence ochraceous to white, distal pale band extremely narrow, usually interrupted medially, not connected at sides to basal pale band, separated from apex of tergum laterally by about length of pale band, interband zone with suberect to erect, short, dark brown hairs, apical area with short,

subappressed to appressed, simple, dark brown hairs (often worn away); terga 3-5 similar to tergum 2 but basal tomentum dark brown and distal pale band often more broadly interrupted (on tergum 5 usually and tergum 4 occasionally distal pubescent band brown); terga 6 and 7 brown; sterna yellow to brown medially, pale laterally; legs with ochraceous to yellow hairs except inner surfaces of basitarsi and often distitarsi yellow to orange.

*Remarks.* As in the case of most species of *Eumelissodes*, *M. bidentis* is an oligoledge of the Compositae and seemingly depends primarily upon plants of the tribe Heliantheae. However the data is at present extremely sparse.

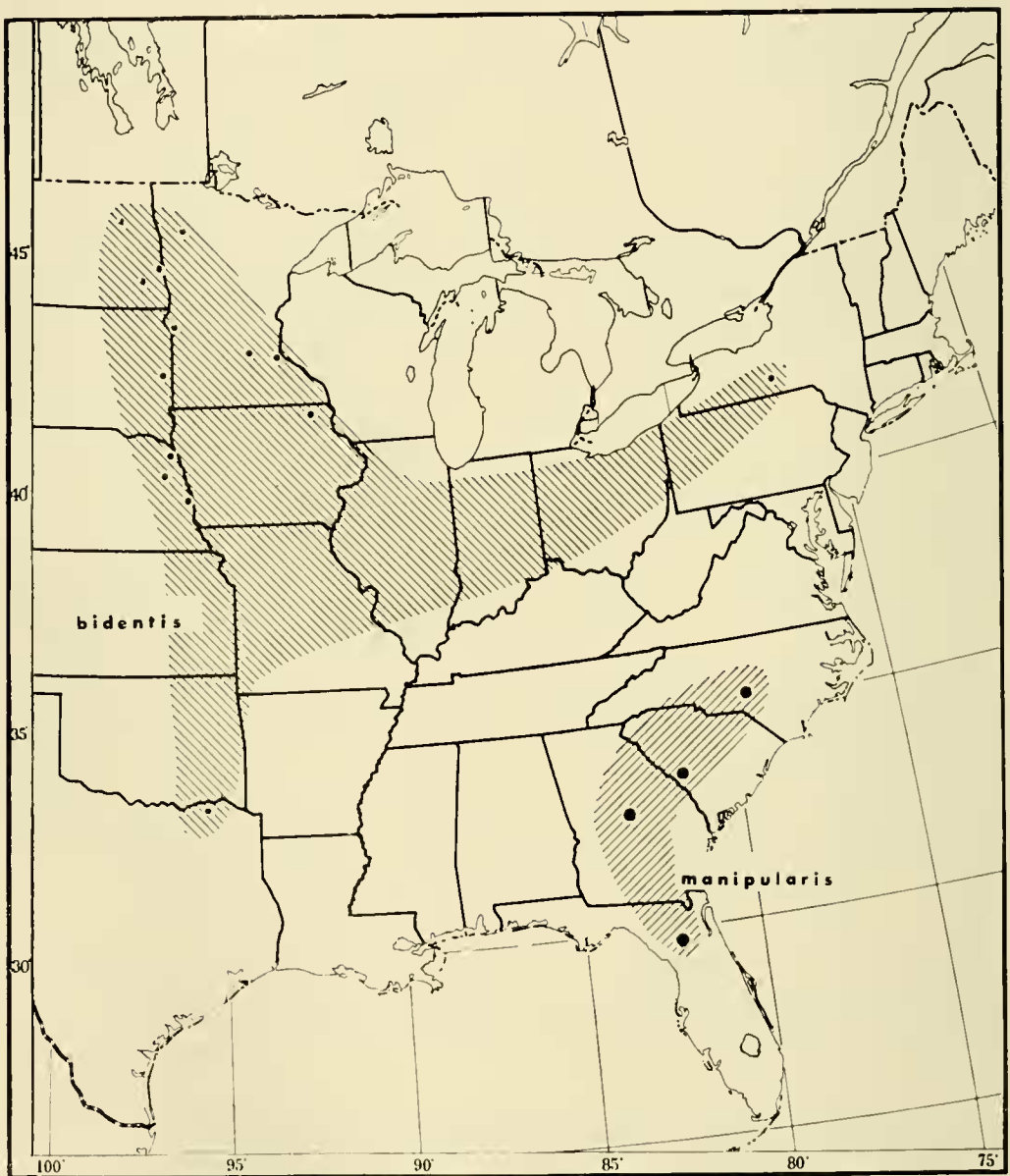


FIG. 11. Map showing the known distributions of *M. (Eumelissodes) bidentis* Cockerell and *M. (E.) manipularis* Smith.



*Type Material.* The holotype female of *bidentis* collected at West Point, Nebraska, September 21, 1903, on *Bidens* sp. by J. C. Crawford is in the U. S. National Museum (U. S. N. M. Type No. 22913). I have also examined one paratype with the same data as the holotype except that it was collected on September 22, 1903, which is in the American Museum of Natural History, New York City.

*Distribution.* The known range of *bidentis* extends from North Dakota to Texas and east to western New York State (Fig. 11). This species has been collected from July 16 to October 8. A total of 26 females and 16 males have been examined (including the holotype) from the localities listed below.

IOWA: Decorah. MINNESOTA: Big Stone Co.; Carver Co. (Zumbro Heights); Hastings; Plummer. NEBRASKA: Omaha; South Sioux City; West Point. NEW YORK: Ithaca. NORTH DAKOTA: Fargo; Lakota; Sheldon. SOUTH DAKOTA: Brookings. TEXAS: Paris.

*Flower Records.* *Bidens* sp., *Echinacea pallida*, *Gossypium herbaceum*, *Helianthus annuus*, *H. maximillianus*, *H. tuberosus*, *Physostegia parviflora*, *Rudbeckia* sp., *R. laciniata*, *Sonchus arvensis*.

### *Melissodes (Eumelissodes) dentiventris* Smith

*Melissodes dentiventris* Smith, 1854, Cat. Hymen. in Coll. British Mus. Part II. Apidae, p. 321; Robertson, 1894, Trans. Acad. Sci. St. Louis, vol. 6, pp. 463, 467, 469-471, 473-476; 1896, Trans. Acad. Sci. St. Louis, vol. 7, pp. 176-178; 1897, Trans. Acad. Sci. St. Louis, vol. 7, p. 355; 1898, Trans. Acad. Sci. St. Louis, vol. 8, p. 53; 1901, Canadian Ent., vol. 33, p. 230; 1902, Canadian Ent., vol. 34, p. 49; Smith, 1910, Ann. Report New Jersey State Mus., 1909, p. 693; Viereck, 1916, Connecticut St. Geol. and Nat. Hist. Surv. Bull. No. 22, p. 732; Cockerell, 1917, Canadian Ent., vol. 49, p. 212.

*Melissodes autumnalis* Robertson, 1905, Trans. Amer. Ent. Soc., vol. 31, p. 369; Cockerell, 1906, Trans. Amer. Ent. Soc., vol. 32, p. 114; Robertson, 1914, Ent. News, vol. 25, p. 70; 1926, Psyche, vol. 33, p. 119; 1926, Ecology, vol. 7, p. 379; 1928, Flowers and Insects, p. 8; Brimley, 1938, Insects of North Carolina, p. 462; Michener, 1947, Amer. Midl. Nat., vol. 38, p. 453.

*Melissodes megacerata* Cockerell, 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 362 (new synonymy).

The female of *dentiventris* resembles closely the darkest female of *trinodis* and those of *bidentis*. The female of *dentiventris* can be separated from those of the latter two species by its flatter clypeus which is more closely allied with the paraocular carina laterally, by its densely tessellate galeae and by its more coarsely punctured metasoma as described below. The male is distinguished by usually lacking pale pubescent bands on the metasomal terga (a complete band is present only on tergum 2 of some specimens),

the dulled galeae, the extremely short first flagellar segment, and by the black mandibles and labrum (often posterior part of clypeus is also darkened).

*Female.* Measurements and ratios: N, 20; length, 12-14 mm.; width, 4.5-6.0 mm.; wing length,  $M = 4.18 \pm 0.058$  mm.; hooks in hamulus,  $M = 14.75 \pm 0.064$ ; flagellar segment 1/segment 2,  $M = 1.74 \pm 0.015$ .

Structure and color: Integument black except as follows: apical half of mandible, lower surface of flagellar segments 3-10 and distitarsi rufescent; eyes gray to blue; wing membranes slightly infumate, yellow, veins dark reddish brown to black; tegulae picous; tibial spurs usually reddish brown.

Clypeus flat, extreme lateral margin separated from eye margin by less than half minimum diameter of first flagellar segment, with coarse round punctures separated by half a puncture width or less, with well-marked median carina in apical half, surface slightly dulled by reticular shagreening; supraclypeal area usually impunctate and shiny medially; flattened lateral areas of vertex with round deep punctures separated by half to one puncture width, surface shiny; galeae above dulled by fine tessellation; maxillary palpal ratio about 2.50:2.67:2.50:1.00, rarely with minute fifth segment. Mesoscutum with large, deep, round punctures separated mostly by half a puncture width (by less in posteromedian declivous area), surface shiny; scutellum similar; mesepisternum with punctures similar in size and spacing to middle of mesoscutum, surface shiny; propodeum with dorsal surface reticulorugose basally and punctate apically, lateral and posterior surfaces coarsely punctate, surfaces dulled by dense, coarse tessellation. Metasomal tergum 1 with basal three-fourths with deep round punctures separated mostly by half to one puncture width, apical area impunctate, surface moderately shiny, with reticulotransverse shagreening (especially basally); tergum 2 with basal area with small deep punctures separated mostly by half a puncture width or less, interband zone with larger, shallow punctures separated mostly by one to two puncture widths, apical area with small punctures two to three times width of hairs arising from them, surface shiny to moderately so, shagreening extremely fine; terga 3 and 4 similar to tergum 2 but punctures of interband zones more crowded; pygidial plate broadly V-shaped with rounded apex.

Hair: Head usually ochraceous with abundant dark brown on vertex, often with dark brown mixed with pale on clypeus and on

frons down to level of antennal fossae, rarely most of head hairs dark. Thorax dark ochraceous to bright rufescent above and on upper half of lateral surfaces, rarely with a few dark brown hairs in posteromedial area of mesoscutum and medially on scutellum, anteriorly and lower lateral surfaces dark brown; tegulae dark brown at least posteriorly. Metasomal vestiture usually entirely dark brown to black except ochraceous (or ochraceous and dark mixed) on basal half of tergum 1 and ochraceous pubescence at extreme base of tergum 2; occasionally tergum 2 with thin distal pubescent band also ochraceous or ochraceous laterally; rarely tergum 3 with distal pubescent band light brown or dark ochraceous laterally. Legs dark brown to black except as follows: inner surfaces of fore and middle tarsi and tibiae reddish brown, inner surfaces of hind basitarsi often dark reddish brown, scopae yellow to ochraceous except brown at apices of basitarsi and on and surrounding basitibial plates.

*Male.* Measurements and ratios: N, 20; length, 10-13 mm.; width, 3.5-5.0 mm.; wing length,  $M = 4.12 \pm 0.188$  mm.; hooks in hamulus,  $M = 13.60 \pm 0.234$ ; flagellar segment 2/segment 1,  $M = 9.61 \pm 0.281$ .

Structure and color: As in female except as follows: clypeus yellow, often dark brown along posterior margin, rarely brown except median one-third; flagellar segments 2-11 yellow to red below; apices of metasomal terga often slightly translucent; tibial spurs usually yellow.

Structure as in female with following differences: minimum length of first flagellar segment usually subequal to pedicel and equal to about one-tenth of maximum length of second segment; maxillary segments in ratio of about 2.0:2.5:2.0:1.0, rarely with fifth segment; basitibial plate rounded apically. Sculpturing as in female except as follows: clypeal punctures less distinct; metasomal tergum 1 with basal four-fifths punctate; terga 3-5 similar to tergum 2 but interband zone punctures smaller and more crowded, apical areas less distinctly punctured than in female.

Sternum 7 as in *agilis* but with median plate subequal to slightly larger than lateral plate in area, with abundant minute hairs ventrally becoming long and coarse basally, and with a few minute, curled hairs directed inwards from dorsum of inner basal angle. Sternum 8 as in *agilis* but ventral tubercle strong and acute. Genital capsule as in *agilis* except as follows: gonostylus equals about half of gonocoxite in length, short, thick hairs basally on ventral surface



with tips split into two or three minute tines; gonocoxite with spicules of inner upper surface half hairlike and half short blunt structures (Figs. 80-81).

**Hair:** Head ochraceous to rufescent (especially on vertex). Thorax pale ochraceous to yellow laterally and ochraceous to bright ferrugineous above. Metasomal tergal vestiture dark brown except as follows: basal half or more of tergum 1 with long pale hairs (reaching apical margin at extreme sides); tergum 2 with basal pubescence pale, distal pubescent band narrow, often white at least in lateral thirds and occasionally across entire tergum; tergum 3 with distal pubescent band occasionally pale laterally; terga 2 and 3 and often 4 with pale hairs along extreme sides. Legs pale ochraceous to yellow except as follows: inner surfaces of basitarsi dark red; inner surfaces of distitarsi and hind tibiae often yellowish red; basitibial plates often pale brown.

**Bionomics.** This species is, according to Robertson (1926), an oligolege of the composite tribes Astereae and Heliantheae. According to the data gathered from specimen labels, *dentiventris* is dependent primarily upon flowers of the tribe Astereae (and particularly upon the genus *Aster*) and only secondarily upon other composites. Out of a total of 39 collections (76 bees) with flower data attached, 24 collections (47 bees of which 44 are females) were from some species of the genus *Aster*. The other 15 collections (29 bees of which only 17 are females) were taken on seven other genera of composites and of these the genus *Chrysopsis* (Astereae) was the most important.

**Type Material.** The holotype male (No. 17.B.834) of *dentiventris* from Georgia is in the collection of the British Museum (Natural History) in London, England. The lectotype female (here designated) of *autumnalis* from Carlinville, Illinois, taken on *Aster ericoides villosus* on September 21, 1895, by Charles Robertson (Robertson No. 17,765), and the lectoallotype male (here designated) collected at Carlinville by Robertson (Robertson No. 18,670) are in the collection of the Illinois Natural History Survey, Urbana, Illinois. In addition, 23 female and 18 male paratypes of *autumnalis* are also at Urbana. The male holotype of *megacerata* collected by G. Birkmann on October 13, 1897, at Fedor, Lee Co., Texas, is in the collection of P. H. Timberlake at the Citrus Experiment Station, Riverside, California.

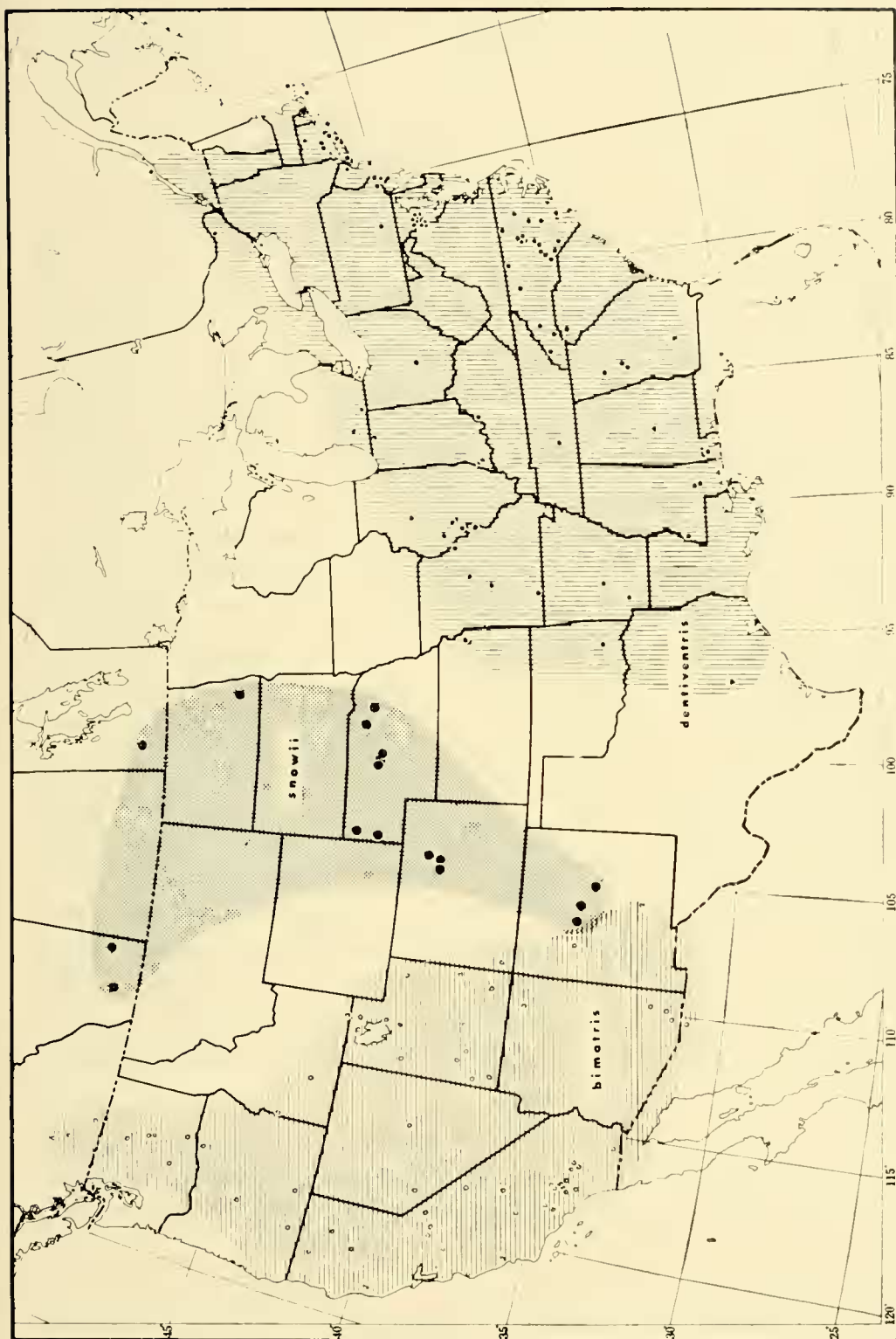


FIG. 12. Map showing the known distributions of *M. (Eumelissodes) dentiventris* Smith, *M. (E.) snowii* Cresson, and *M. (E.) bimacris* LaBerge.

*Distribution.* This species ranges from eastern Texas north to South Dakota and east to Georgia and southeastern Canada (Fig. 12). It has been collected from July 4 to October 27, but chiefly in September and October. In addition to the type material, 270 females and 108 males from the localities listed below have been examined. This list includes records reported in the literature.

ALABAMA: Kushla; Mobile; Saraland; Selma. ARKANSAS: Hope; Hot Springs. CONNECTICUT: Branford; Rockville; Westville. DISTRICT OF COLUMBIA: Washington. GEORGIA: Atlanta; Griffin; Neal Gap; Thomsons Mills; Tifton. ILLINOIS: Bluffs; Carlinville; Elsah, Jersey Co.; Macoupin Co.; Peoria. INDIANA: Elkhart; Gibson Co.; Rush Branch. KANSAS: Lawrence; Lone Star Lake, Douglas Co. KENTUCKY: Louisville. MARYLAND: Beltsville; Bethesda; Bladensburg; Cabin John; Glen Echo; Hyattsville. MASSACHUSETTS: Edgartown; Truro; Woods Hole. MICHIGAN: Hillsdale Co.; Kalamazoo Co. MISSISSIPPI: Camp Shelby (near Hattiesburg); Hattiesburg; Natchez. MISSOURI: Branson; Columbia; Louisiana; Ozark Lake; St. Louis. NEW JERSEY: Clementon; Da Costa; Gloucester Co.; Iona; Lakewood; Maplewood; Riverton. NEW YORK: Long Island (Bellmore; East Quogue; Flatbush; Greenport; Montauk; Northwest; Orient). NORTH CAROLINA: Black Mt.; Bryson City; Burgaw; Crabtree Creek State Park; Davidsons River; Faison; Harnett Co.; Lake View; Lumberton; Laurinburg; New River; Norlina; Pender Co.; Pikeville; Raleigh; Reidsville; Richmond Co.; Spout Spring; Southern Pines; Tarboro; Umstead State Park; Wake Co.; West Raleigh; Yadkin Co. OHIO: Franklin Co. OKLAHOMA: Tuskahoma. PENNSYLVANIA: Eberlys Mill; Philadelphia. SOUTH CAROLINA: Greenville. TENNESSEE: Maury Co. TEXAS: Fedor, Lee Co. VIRGINIA: Barcroft; Falls Church; Fort Humphreys; Four-mile Run (near mouth of). *Canada.* ONTARIO: Ottawa. QUEBEC: Cap Rouge.

*Flower Records.* *Aster* sp., *A. anomalus*, *A. dumosus*, *A. ericoides*, *A. ericoides villosus*, *A. novaeangliae*, *A. paniculatus*, *A. sagittifolius*, *A. turbinellus*, *Bidens aristosa*, *B. polylepis*, *Boltonia asteroides*, *Coreopsis tripteris*, *Chrysopsis* sp., *C. mariana*, *C. microcephala*, *Eupatorium perfoliatum*, *E. serotinum*, *Helianthus* sp., *H. annuus*, *H. divaricatus*, *H. grosse-serratus*, *H. radula*, *Isopappus divaricatus*, *Lespedeza virginica*, *Lippia lanceolata*, *Polygonum pennsylvanicum*, *Solidago canadensis*, *S. rigida*, *S. ulmifolia*, *Verben hastata*, *Vernonia* sp., *Veronica* sp.



*Melissodes (Eumelissodes) perlusa* Cockerell

*Melissodes semiagilis* var. *perlusa* Cockerell, 1925, Ann. Mag. Nat. Hist., ser. 9, vol. 16, p. 231; 1926, Univ. Colorado Studies, vol. 16, p. 114.

The female of *perlusa* is similar to that of *agilis* but differs in that the lateral clypeal carina is closer to the eye, the metasomal terga are more finely punctate and the galeae are shinier. The female is also distinctive in having reddish wing veins, very pale vestiture and often red hairs on the inner surfaces of the hind basitarsi. The male of *perlusa* is similar to that of *agilis* except for the slightly longer first flagellar segment, the less coarsely punctate metasomal terga, the shiny galeae and the black mandibular bases.

*Female.* Measurements and ratios: N, 20; length, 12-14 mm.; width, 4.5-6.0 mm.; wing length,  $M = 3.88 \pm 0.183$  mm.; hooks in hamulus,  $M = 14.50 \pm 0.212$ ; flagellar segment 1/segment 2,  $M = 1.95 \pm 0.029$ .

Structure and color: Integument color as in *agilis* except as follows: eyes greenish blue; apical area of tergum 1 usually translucent (even narrowly hyaline in some).

Sculpturing and structure as in *agilis* except as follows: clypeal punctures usually slightly smaller, crowded, apicomedial longitudinal carina usually present, protruding beyond eye in profile by less than half width of eye, lateral carina separated from eye margin by half or slightly more of minimum diameter of first flagellar segment; galeae above shiny, unshagreened or extremely delicately so; maxillary palpal ratio about 4.5:3.5:3.0:1.0; vertex with lateral flattened areas with minute punctures separated by one to three puncture widths, surface shiny. Mesoscutum as in *agilis* but punctures slightly larger, surface not shagreened; scutellar punctures smaller than mesoscutal. Metasomal tergum 1 with basal two-thirds or less punctate, punctures round, small, distinct, separated mostly by one puncture width, surface dulled by reticular shagreening (almost tessellate in appearance), apical area impunctate, moderately shiny, finely shagreened; tergum 2 with basal zone with minute round punctures separated by one to two puncture widths, surface dulled by dense tessellation, interband zone impunctate or with sparse punctures not much larger than base of hairs arising from them, surface dulled by tessellation, apical area impunctate or virtually so, surface dulled by coarse reticulo-transverse shagreening; terga 3 and 4 similar to 2 but apical area of tergum 4 covered by distal pubescent band.

Hair: On head pale ochraceous to dark ochraceous, often yellow-

ish on vertex and occasionally vertex with sparse brown hairs. Thorax pale ochraceous or white laterally and posteriorly and dull ochraceous to dull rufescent (usually yellowish) above, without brown. Metasomal vestiture as in *agilis* except as follows: pale vestiture never rufescent, usually white to ochraceous; tergum 1 with apical area glabrous; tergum 2 with pale interband zone hairs never brown, erect to suberect, long, with distal pale band rarely interrupted medially, of about equal length across tergum and almost as long as apical area medially, with apical area hairs always pale ochraceous or white, suberect, distinctly plumose and more abundant than in *agilis*; tergum 3 as in tergum 2 but apical area narrower, basal tomentum brown and distal pale pubescence invading interband zone; tergum 4 as in *agilis* but distal pale band broader and never with minute apicomedian brown area; sterna yellow to pale brown medially, paler laterally. Legs pale ochraceous to white except as follows: outer surface of fore basitarsi, outer surface of apical area of middle tibiae and on and surrounding basitibial plates pale brown; inner surfaces of tarsi and hind tibiae yellow to dark reddish brown.

*Male.* Measurements and ratios: N, 20; length, 10-13 mm.; width, 3-4 mm.; wing length,  $M = 3.49 \pm 0.197$  mm.; hooks in hamulus,  $M = 12.95 \pm 0.223$ ; flagellar segment 1/segment 2,  $M = 5.42 \pm 0.095$ .

Structure and color: Integumental color as in *agilis* except as follows: mandibular bases without yellow spots; labrum with medio-basal pale spot present or absent; eyes yellowish green; tergal margins hyaline, colorless.

Structure as in *agilis* except as follows: clypeus protruding beyond eye in profile by less than half width of eye; first flagellar segment with minimum length equal to one-fifth or slightly more of maximum length of second segment, usually about one and one-half times as long as pedicel on that side; maxillary palpal ratio about 7:4:4:1, last segment often shorter. Sculpturing as in female except as follows: clypeal punctures less distinct; supraclypeal area often shiny; galeae usually unshagreened, or with delicate reticular shagreening.

Sternum 7 as in *dentiventris* but median plate with basoventral hairs more slender and sparser, median plate slightly larger than lateral plate. Sternum 8 as in *agilis*. Genital capsule as in *agilis* but hairs of gonostylus and gonocoxite as in *dentiventris* although sparser and more slender.

Hair: Head and thorax white to pale ochraceous, often slightly darker on upper surface of thorax and on vertex. Metasomal terga as in *agilis* but pale vestiture always white to extremely pale ochraceous, vestiture longer, terga 2-4 with suberect hairs of apical areas long and distinctly plumose, without brown. Legs white to pale ochraceous except inner surfaces of tarsi yellow to pale reddish yellow.

*Bionomics.* *M. perlusa* is probably an oligolege of the genus *Helianthus*. Too few collections with flower data are available to arrive at a definite conclusion. Of 38 collections (58 bees) available with flower data, 23 collections (12 females and 28 males) were made on some species of *Helianthus* (the majority on *H. petiolaris*). Of the remaining 15 collections (18 bees), 8 (7 females and 3 males) were made on some other composite and 7 (4 females and 4 males) were made on either legumes or labiates.

*Type Material.* The holotype male of *perlusa* from Mesa Verde, Colorado, July 3-7, 1919, is in the collection of the American Museum of Natural History in New York City. Two paratype males with the same locality data are in the collection of P. H. Timberlake at the Citrus Experiment Station, Riverside, California.

*Distribution.* *M. perlusa* ranges from Arizona and New Mexico north to Alberta and Manitoba in the western prairies and eastern Rocky Mountains (Fig. 10). It has been collected from June 20 to September 26, but mainly in July and August. In addition to the holotype, 48 females and 49 males from the localities listed below have been examined.

ARIZONA: Flagstaff. COLORADO: Alder; Berkley; Boulder; Clear Creek; Cortez; Golden; Larimer Co.; Mesa Verde; Peetz, San Luis Valley; Tobe. IOWA: Lyon Co. NEBRASKA: Glen, Sioux Co.; Harrison; Mitchell; Monroe Canyon, Sioux Co. NEW MEXICO: Embudo; Jemez Springs; Las Cruces; Rowe; San Jose; Santa Fe; Vaughn. NORTH DAKOTA: Beach; Dickinson; Marmarth; Medora; Nicholson; Valley City; Washburn; Williston. UTAH: Kanarrville. WYOMING: Torrington; Worland. Canada. ALBERTA: Lethbridge; Medicine Hat; Suffield; Whitla. MANITOBA: Aweme.

*Flower Records.* *Biglovia* sp., *Brauneria pallida*, *Grindelia* sp., *Helianthus* sp., *H. annuus*, *H. petiolaris*, *Lepachys* sp., *Medicago sativa*, *Mentha canadensis*, *Petalostemum* sp., *P. oligophyllum*, *Ratibida columnaris*.



*Melissodes (Eumelissodes) snowii* Cresson

*Melissodes snowii* Cresson, 1872, Proc. Acad. Nat. Sci. Philadelphia, vol. 24, p. 211; Robertson, 1898, Trans. Acad. Sci. St. Louis, vol. 8, p. 53; Bridwell, 1899, Trans. Kansas Acad. Sci., vol. 16, p. 211; Cockerell, 1906, Trans. Amer. Ent. Soc., vol. 32, p. 76; Tucker, 1909, Trans. Kansas Acad. Sci., vol. 22, p. 281; Cresson, 1916, Mem. Amer. Ent. Soc., vol. 1, p. 130.

This species is extremely close to *M. perlusa* Cockerell. The female of *snowii* is similar to that of *perlusa* in most respects; however, *snowii* females have slightly more distinct punctures in the interband zone of tergum 2, often darker hairs on the inner surfaces of the hind basitarsi, more distinctly sculptured galeae and shorter and less plumose hairs in the apical areas of terga 2 and 3. The males of *snowii* are readily distinguished from those of *perlusa* by the yellow mandibular bases. They can be separated from the palest males of *agilis* only with difficulty, but the extremely short first flagellar segment and the white vestiture are distinctive. The males also resemble the males of *M. nivea* Robertson as discussed in the diagnosis of that species.

*Female.* Measurements and ratios: N, 20; length, 12-13 mm.; width, 3.5-4.5 mm.; wing length,  $M = 3.35 \pm 0.116$ ; hooks in hamulus,  $M = 12.85 \pm 0.608$ ; flagellar segment 1/segment 2,  $M = 1.86 \pm 0.022$ .

Structure and color: Integumental color as in *perlusa* except eyes usually blue, gray or greenish blue. Sculpturing and structure as in *perlusa* except as follows: lateral clypeal carina separated from eye margin by more than half and usually by one-third to three-fourths minimum diameter of first flagellar segment; galea above dulled by fine, dense tessellation; maxillary palpal ratio about 3.2:3.2:3.2:1.0; mesoscutal punctures often slightly larger and sparser in posteromedian area; metasomal tergum 1 with basal three-fourths or less with punctures separated mostly by half to one puncture width, surface shiny with coarsely reticular shagreening, interband zone with small shallow punctures separated mostly by two to three puncture widths, surface moderately shiny, apical area with minute punctures or impunctate, surface moderately shiny; tergum 3 as in tergum 2 but interband zone punctures more abundant and more distinct.

Hair: Head white, a few brown hairs often present on vertex. Thorax white, often extremely pale ochraceous above. Metasomal vestiture as in *perlusa* but pale vestiture always white, never ochraceous, apical areas of terga 2 and 3 with subappressed hairs simple or plumose only at extreme base, short and a few (especially on

tergum 3) often pale brown, and sterna brown except white laterally. Legs white except as follows: fore tarsi, outer surfaces of middle tibiae (near apices) and often basitarsi, and on and surrounding basitibial plates brown; scopae white to extremely pale ochraceous; inner surfaces of basitarsi and hind tibiae yellow to brownish red.

*Male.* Measurements and ratios: N, 20; length, 10-12 mm.; width, 3.5-4.0 mm; wing length,  $M = 3.23 \pm 0.087$ ; hooks in hamulus,  $M = 11.80 \pm 0.186$ ; flagellar segment 2/segment 1,  $M = 10.24 \pm 0.188$ .

Structure and color: Integumental color as in *perlusa* except as follows: mandibular bases with large yellow spots; labrum white except narrow brown apical margin (more than half of area pale); eyes bluish gray to greenish blue; tegulae usually piceous; wing veins yellow; flagellar segments 2 to 11 yellow below, red above.

Structure as in *perlusa* except as follows: first flagellar segment with minimum length to about one-tenth of maximum length of second segment and subequal to pedicel on same side; maxillary palpal ratio about 3:3:3:1. Sculpturing as in female except as follows: clypeus with punctures less distinct; galeae with tessellation finer, often shiny and unshagreened or tessellate except in apical third; mesoscutum with posteromedian area punctures often separated by 3 or more puncture widths; metasomal tergum 1 with basal four-fifths with punctures separated by half to one or slightly more puncture widths.

Sternum 7 as in *perlusa* with median plate with apical margin transverse and ventral hairs minute, sparse and more delicate medio-basally. Sternum 8 as in *agilis* but apical hairs minute and ventral tubercle usually not bidentate apically, cariniform. Genital capsule as in *agilis* but inner apical spicules of gonocoxite at least half short and blunt and gonostylus subequal to half of gonocoxite (Figs. 82-83).

Hair: Vestiture entirely white, rarely slightly grayish or yellowish on dorsum of thorax. Tergal vestiture as in *perlusa* except as follows: terga 2 and 3 with apical areas with suberect hairs long, white, simple except a few plumose at extreme bases; tergum 2 with distal pubescent band usually as long medially as apical area. Legs white except inner surfaces of basitarsi and often distitarsi yellow.

*Bionomics.* This bee is probably oligolectic on Compositae. The females have been collected most often on *Helianthus* and

*Solidago*, but there is not sufficient information for a more adequate statement of flower preferences. The only non-composite on which females have been taken is *Medicago sativa*.

*Type Material.* Lectotype male (No. 2330) and one male paratype collected by Snow in Colorado are in the collection of the Philadelphia Academy of Natural Sciences.

*Distribution.* *M. snowii* ranges over the western parts of the Great Plains from Alberta in the north to New Mexico in the south (Fig. 12). It has been collected from July 10 to September 18, but mostly during August. In addition to the type material, 30 females and 26 males have been examined from the localities listed below. A majority of these 56 specimens are from Halsey, Nebraska.

COLORADO: Boxelder Creek (E. of Aurora); Denver; Roggen. NEBRASKA: Dunning; Glen, Sioux Co.; Halsey; Holt Co.; Mitchell; Neligh; Thedford. NEW MEXICO: Albuquerque; Moriarity; Vaughn. NORTH DAKOTA: Sheldon. Canada. ALBERTA: Lethbridge; Seven-persons. MANITOBA: Aweme.

*Flower Records.* *Aster* sp., *Cleome serrulata*, *Gaillardia* sp., *Gutierrezia sarothrae*, *Helianthus* sp., *H. petiolaris*, *H. subrhomboides*, *Lacinaria punctata*, *Medicago sativa*, *Solidago missouriensis*, *S. nemoralis*, *S. rigida*.

### *Melissodes (Eumelissodes) submenuacha* Cockerell

*Melissodes menuacha* var. *submenuacha* Cockerell, 1897, Entomologist, vol. 30, p. 137; 1877, New Mexico Col. Agric. and Mech. Arts, Bull. No. 24, p. 28; 1898, Bull. Sci. Lab. Denison Univ., vol. 11, p. 66; 1898, Bull. Univ. New Mexico, vol. 1, p. 66; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309.  
*Melissodes hewetti* Cockerell, 1905, Ann. Mag. Nat. Hist., ser. 7, vol. 15, p. 527 (new synonymy); 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 84, 86; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309.

This large pale species is very similar in appearance to *M. perlusa* Cockerell. The females of *submenuacha* can be separated from those of *agilis* by the coarser clypeal punctation and by the lateral clypeal carina being closer to the eye margin. They can be separated from the females of *perlusa* by the slightly larger size, the dark wing veins, the coarser clypeal punctures, the denser punctures of the basal area of tergum 2, and the usually shagreened surface of the mesoscutum. The males of *submenuacha* are similar to those of *perlusa* in the dark mandibular bases, the flatter clypeus, the less coarsely punctate terga and the shinier galeae, but differ from those of *perlusa* by the short first flagellar segment and the sculpturing of the mesoscutum and base of tergum 2 as described below.



*Female.* Measurements and ratios: N, 10; length, 13-15 mm.; width, 4.5-6.0 mm.; wing length,  $M = 4.54 \pm 0.211$  mm.; hooks in hamulus,  $M = 15.90 \pm 0.100$ ; flagellar segment 1/segment 2,  $M = 2.13 \pm 0.032$ .

Structure and color: Integument black except as follows: mandible with apical half or more, usually apical margin of clypeus, flagellar segments 3-10, tarsi and often tibiae at least partly, occasionally apical areas of terga 2-4 rufescent; eyes grayish brown to grayish green; wing membranes colorless, veins dark reddish brown to black; tegulae testaceous, yellow to rufescent; tibial spurs yellow to red.

Structure and sculpturing as in *perlusa* except as follows: clypeus separated from eye margin laterally by about three-fourths minimum diameter of first flagellar segment, with coarse, irregularly round punctures separated mostly by half a puncture width or less, usually with longitudinal median carina in apical half or more, surface shiny, with sparse delicate cross-striations; supraclypeal area sparsely or not punctate medially, shiny, usually with coarse reticular shagreening; galeae usually with coarse reticular shagreening dulling apical half or more above; maxillary palpal segments in ratio of about 4.0:4.0:2.5:1.0; mesoscutum with posteromedian area with surface slightly dulled by coarsely reticular shagreening; metanotum and propodeum with reticulorugosity finer, tessellation coarser; metasomal tergum 1 with basal three-fifths with punctures separated by one to three puncture widths, surface with finely reticular shagreening; tergum 2 with basal area with minute punctures separated by half to one puncture width, apical area with surface somewhat dulled by fine reticulotransverse shagreening.

Hair: Head pale ochraceous to ochraceous (brighter on vertex), vertex often with sparse dark brown hairs. Thorax laterally and posteriorly white to pale ochraceous, ochraceous to yellow above, scutellum often with brown medially and mesoscutum rarely with a few brown hairs posteromedially. Metasomal vestiture as in *perlusa* except as follows: pale vestiture not usually white but pale ochraceous; tergum 2 with distal pale band much thinner medially than laterally (interrupted when worn) and usually about one-half to three-fourths length of apical area medially; terga 2 and 3 with apical areas with subappressed to suberect hairs short, plumose only in basal half or less (seemingly simple except when highly magnified), often pale brown partially at least on tergum 3; tergum 4 with distal pale band extremely broad; terga 5 and 6 with median

dark hairs golden brown, yellow laterally; sterna golden medially to pale ochraceous laterally. Legs as in *perlusa* except scopae pale yellow to pale ochraceous.

*Male.* Measurements and ratios: N, 20; length, 12-14 mm.; width, 4-5 mm.; wing length,  $M = 4.14 \pm 0.170$  mm.; hooks in hamulus,  $M = 14.15 \pm 0.287$ ; flagellar segment 2/segment 1,  $M = 7.33 \pm 0.105$ .

Structure and color: Integumental color as in *agilis* except as follows: mandibular bases without yellow; labrum with or without mediobasal pale spot; first flagellar segment usually wholly dark brown; eyes yellow to yellowish green; tergal margins extremely broadly hyaline (apical third or more of tergum 1 and almost half of terga 2 and 3), colorless or yellow; wing veins reddish brown to dark brown.

Structure as in *perlusa* except as follows: minimum length of first flagellar segment equals less than one-sixth (usually about one-seventh) of maximum length of second segment, usually longer than pedicel on same side; maxillary palpal segments in ratio of about 8:7:5:1, last segment often twice as long. Sculpturing as in female except as follows: supraclypeal area often unshagreened; mesoscutellar shagreening often absent or extremely fine; tergum 1 with basal five-sixths to four-fifths punctate.

Sternum 7 as in *snowii* but median plate with apical margin inclined towards midline. Sternum 8 and genital capsule as in *snowii*.

Hair: Head and thorax pale ochraceous to ochraceous, usually somewhat brighter on vertex and dorsum of thorax. Metasomal terga as in *perlusa* except as follows: vestiture usually pale ochraceous rather than white; terga 3-5 with interband zones with abundant, long, appressed pubescence (less abundant than in distal pubescent bands, however). Legs pale ochraceous to white except yellow on inner surfaces of tarsi.

*Type Material.* Cockerell did not specify a single holotype for *submenuacha* in his original description and none has been found in collections in this country. However, four males from "Las Cruces, N. M., 9-5" have been examined. These are presumably part of the original type series. One male has "*submenuacha* Ck11." on a second label written in Cockerell's distinctive handwriting. A second of these has a note in Cockerell's handwriting which records the characters which Cockerell published in the original description and a second note by Fox agreeing to the notes by

Cockerell. These males are evidently those cited by Cockerell as being collected by C. H. Townsend. That male labeled *submenuacha* Ck11. is hereby designated as the lectotype of *submenuacha*. The lectotype is in the collection of the Natural History Museum of the University of Colorado at Boulder.

It is interesting that although no males have been seen from Las Cruces collected by Cockerell on September 22nd, as he states in the original description, a single female of *submenuacha* from Las Cruces collected on *Helianthus annuus* (which is mentioned in the description) on September 22nd by Cockerell has been examined. Another label on this specimen reads "*submenuacha* n. sp." Could Cockerell have recorded this female as a male in writing the description for publication? The holotype female of *hewetti* from Santa Fe, New Mexico, collected by T. D. A. Cockerell on *Cleome serrulata* in August is in the collection of P. H. Timberlake of the Citrus Experiment Station, Riverside, California.

*Distribution.* *M. submenuacha* is known from Arizona, New Mexico and western Texas (Fig. 13). It has been collected from May 11 to November 10, but chiefly in September. In addition to the holotype, 10 females and 22 males from the localities listed below have been examined.

ARIZONA: Cameron (19 miles W.); Cochise Co.; Douglas; Madera Canyon, Santa Rita Mts.; Nicks (Huachuca Mts.); Portal (3, 5 and 10 miles E.); Sabino Canyon, Santa Catalina Mts.; Sedona (and 15 miles S.); Theba; Tucson. NEW MEXICO: Albuquerque; Embudo; Hurley; Las Cruces; Santa Fe; Wilna. TEXAS: Big Bend State Park (Hot Springs); El Paso; Hueco Mts. (W. side of), El Paso Co.

*Flower Records.* *Aploppapus gracilis*, *Bidens* sp., *Cleome serrulata*, *Helianthus* sp., *Hymenothrix wislizeni*, *Isocoma heterophylla*, *Medicago sativa*, *Verbesina encelioides*. Although *submenuacha* is probably an oligolege of the Compositae, there is not sufficient evidence to make a more precise statement of its flower preferences at this time.

### *Melissodes (Eumelissodes) menuachus* Cresson

*Melissodes menuachus* Cresson, 1868, Trans. Amer. Ent. Soc., vol. 1, p. 388; 1875, in Wheeler, Report Geog. Geol. Surv. west of 100th Meridian, vol. 5, p. 727; 1876, Proc. Davenport Acad. Nat. Sci., vol. 1, p. 209; Cragin, 1886, Bull. Washburn Coll. Lab. Nat. Hist., vol. 1, p. 211; Cockerell, 1893, Trans. Amer. Ent. Soc., vol. 20, p. 338; Fox, 1893, Proc. California Acad. Sci., ser. 2, vol. 4, p. 118; Townsend, 1896, Canadian Ent., vol. 28, p. 139; Cockerell, 1897, Entomologist, vol. 30, p. 138; 1897, Bull. Agric. Exp. Sta. New Mexico Coll. Agric. and Mech. Arts, no. 24, p. 19; 1898, Zoologist, p. 313; 1898,



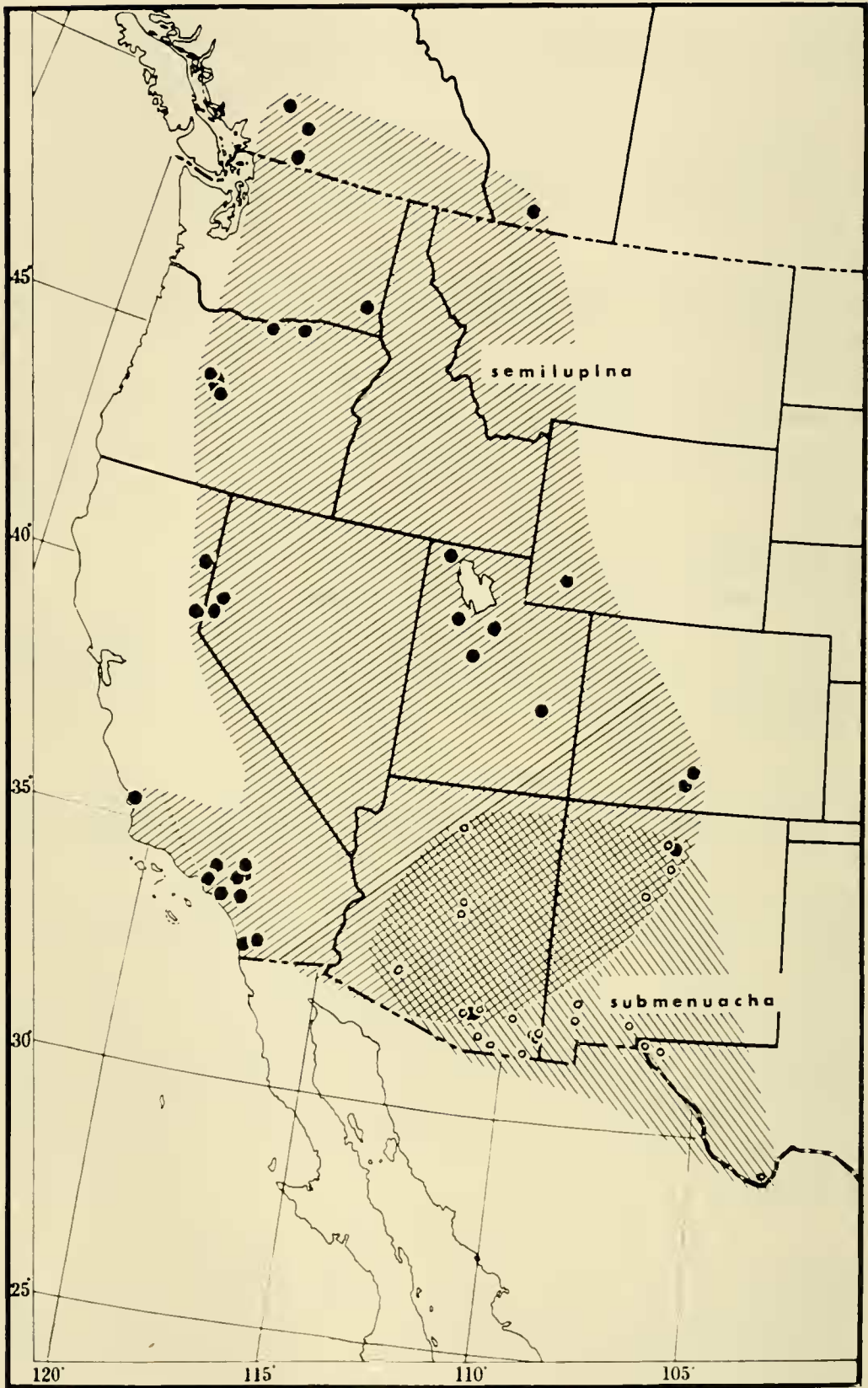


FIG. 13. Map showing the known distributions of *M.* (*Eumelissodes*) *semilupina* Cockerell and *M.* (*E.*) *submenuacha* Cockerell.

- Bull. Univ. New Mexico, vol. 1, pp. 66, 67, 73; 1898, Bull. Sci. Lab. Denison Univ., vol. 11, pp. 66, 67, 73; 1899, Catalogo de las Abejas de Mexico, p. 14; Birkman, 1899, Trans. Kansas Acad. Sci., vol. 16, p. 211; Fowler, 1902, Univ. California Agric. Exp. Sta., p. 322; Cockerell, 1903, Psyche, vol. 10, p. 77; 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 12, p. 449; Viereck, 1905, Canadian Ent., vol. 37, p. 320; Cockerell, 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 77, 86, 92; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309; 1906, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 443; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 137; Tucker, 1909, Trans. Kansas Acad. Sci., vol. 22, p. 282; Smith, 1910, Ann. Rept. New Jersey State Mus., 1909, p. 693; Cockerell, 1910, Psyche, vol. 17, p. 246; 1910, Ent. News, vol. 10, p. 4; 1912, Proc. U. S. Nat. Mus., vol. 43, p. 271; Cresson, 1916, Mem. Amer. Ent. Soc., vol. 1, p. 123; Bray, 1917, Pomona Jour. Ent. Zool., vol. 9, p. 94.
- Melissodes mennacus* (!) Uhler, 1877, Bull. U. S. Geol., Geog. Surv., vol. 3, p. 783.
- Melissodes pallida* Robertson, 1895, Trans. Amer. Ent. Soc., vol. 22, p. 127 (new synonymy); 1905, Trans. Amer. Ent. Soc., vol. 31, p. 369; 1928, Flowers and Insects, p. 8.
- Melissodes mizeae* Cockerell, 1905, Ann. Mag. Nat. Hist., ser. 7, vol. 15, p. 522 (new synonymy); 1906, Trans. Amer. Ent. Soc., vol. 32, p. 86; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309; 1907, Univ. Colorado Studies, vol. 4, p. 255; Hicks, 1926, Univ. Colorado Studies, vol. 15, p. 225; Cockerell, 1933, Ann. Ent. Soc. Amer., vol. 26, p. 44.
- Melissodes blakei* Cockerell, 1905, Ann. Mag. Nat. Hist., ser. 7, vol. 15, p. 523 (new synonymy); 1906, Trans. Amer. Ent. Soc., vol. 32, p. 107; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309; 1927, Ann. Ent. Soc. Amer., vol. 20, p. 396.
- Melissodes lavata* Cockerell, 1924, Pan-Pacific Ent., vol. 1, p. 56 (new synonymy); 1927, Ann. Ent. Soc. Amer., vol. 20, p. 395; 1928, Univ. Colorado Studies, vol. 16, p. 114.
- Melissodes octobris* Cockerell, 1934, Ent. News, vol. 45, p. 30 (new synonymy).

This species is a large pale bee closely related to *M. submenuacha* Cockerell. The female of *menuachus* can be distinguished from any of the preceding species by the second flagellar segment being longer than broad and by the color of the vestiture as described below. The male of *menuachus* is similar in size to that of *submenuacha*, but has pale spots at the base of the mandible, as well as a pale labrum, and has the first flagellar segment longer in relation to the second segment.

*Female.* Measurements and ratios: N, 20; length, 13-16 mm.; width, 4.0-5.5 mm.; wing length,  $M = 4.56 \pm 0.180$  mm.; hooks in hamulus,  $M = 16.15 \pm 0.254$ ; flagellar segment 1/segment 2,  $M = 1.83 \pm 0.016$ .

Structure and color: Integumental color as in *submenuacha* except as follows: eyes grayish blue to greenish gray; wing membranes slightly milky, veins red to reddish brown; tegulae usually testaceous.

Structure as in *agilis* except as follows: clypeus flat, protruding beyond eye in profile by one-third or less of eye width, with small, crowded, round punctures, surface dulled by coarse reticular shagreening, with distinct median longitudinal carina in apical half;

supraclypeal area shiny, often with coarse reticular shagreening but scarcely dulling surface; galeae shiny, with delicate shagreening above in apical half or less; maxillary palpal ratio about 5.0:4.5:3.0:1.0, vertex with lateral flattened areas with minute sparse punctures, shiny; second flagellar segment ventrally slightly longer than broad. Mesoscutum with large deep punctures of rather variable diameter separated mostly by one-half to one puncture width, surface shiny; scutellum similar but punctures more crowded; mesepisternum with large shallow punctures separated mostly by much less than half a puncture width, surface shiny with extremely sparse and delicate shagreening. Metasomal tergum 1 with impunctate apical area expanded basally at sides to form two small, impunctate lateral lobes.

Hair: Head white except usually ochraceous on vertex. Thorax white to pale ochraceous laterally and posteriorly, bright to pale ochraceous above. Metasomal tergum 1 with basal area with long pale ochraceous hairs, apical area glabrous, pale basal hairs not reaching apical margin of tergum except at extreme sides; tergum 2 with basal white pubescence connected with distal pale band at sides, interband area with sparse, subappressed, relatively simple, pale hairs, distal pale band twice as long as apical apubescent area laterally, notched on posterior border at midline where usually half as long as apical area, apical area glabrous; tergum 3 similar to 2 but basal tomentum dark brown, distal pale band separated from apex by a narrow zone of suberect, pale relatively simple hairs, tergum 4 similar to 3 but apical suberect hairs absent; terga 5 and 6 brown except thick lateral white tufts; sterna brown medially to white at extreme sides. Legs white to pale ochraceous except as follows: fore tarsi, outer apex of fore and middle tibiae, on and surrounding basitibial plate, and inner surfaces of hind basitarsi brown to dark reddish brown; scopal hairs extremely long, usually pale yellow, occasionally pale ochraceous.

*Male.* Measurements and ratios: N, 20; length, 12-15 mm.; width, 3.5-5.0 mm.; wing length,  $M = 4.22 \pm 0.181$  mm.; hooks in hamulus,  $M = 14.25 \pm 0.239$ ; flagellar segment 2/segment 1,  $M = 5.00 \pm 0.083$ .

Structure and color: Integument black except as follows: clypeus and base of mandible yellow; labrum white except narrow apical margin brown; flagellum yellow to red below and brown to dark red above except first segment often entirely dark; eyes grayish yellow to greenish gray; distitarsi rufescent; wing membranes



hyaline, veins yellow to pale red; tegulae testaceous; apical areas of metasomal terga hyaline, colorless to yellow.

Structure as in *agilis* except as follows: minimum length first flagellar segment equals about two-thirds maximum length of first segment and about one-fifth (or slightly less) maximum length second segment; maxillary palpal ratio about 2.5:2.3:2.3:1.0; clypeus flat. Sculpturing as in female except as follows: galeae above shiny, with apical half often delicately shagreened; tergum 1 with basal four-fifths punctate, punctures usually somewhat larger, deeper and more crowded than in female; terga 3 and 4 with interband zone with small round punctures separated mostly by one to three puncture widths, occasionally mostly by one puncture width or less, surface dulled by coarse, reticular shagreening; tergum 5 similar but punctures more crowded.

Sterna 7 and 8 as in *submenuacha*. Genital capsule as in *submenuacha* but gonostylus with hairs on ventral surface near base short, stout, blunt, sparse, on outer lower surface mostly short, stout and bifid or trifid at apex; gonocoxite with several apical short, stout, blunt spicules on ventral surface below gonostylus in addition to those on inner apical surface (the latter are as in *submenuacha*).

Hairs: Head and thorax white to pale ochraceous, often brighter on vertex and dorsum of thorax. Metasomal tergum 1 with long white to ochraceous hairs basally, apically with long, appressed to subappressed pale hairs reaching margin of tergum (in fresh specimens) not obscuring apical area of tergum at least medially; tergum 2 with white pubescence basally, suberect, bristlelike, pale hairs in interband zone, white to pale ochraceous distal pubescent band not interrupted medially (unless worn) and separated from apical margin by one-half to one times length of pale band medially; terga 3-5 similar except interband zones with sparse, delicate, white, appressed pubescence in addition to bristlelike hairs and distal bands progressively closer to apical margin; terga 6 and 7 white to yellowish; sterna pale ochraceous to reddish medially, white laterally. Legs white to ochraceous except inner surfaces of tarsi golden yellow to pale rufescent.

*Bionomics.* Hicks (1926, p. 225) has recorded a few notes concerning the biology of *M. menuachus*. He discovered two females of *menuachus* nesting in the ground near Boulder, Colorado. On account of the condition of the soil, Hicks was unable to excavate these nests, although he did observe the females carrying pollen into their burrows. In both instances he observed a female of

*Triepeolus occidentalis* Cresson enter the burrow while the female *Melissodes* was absent. Apparently *T. occidentalis* is a parasite of *M. menuachus* in that region.

*M. menuachus* is dependent upon flowers of the family Compositae and in particular upon the genera *Grindelia* and *Solidago*, according to the collection data available at this time. This is clearly shown in Table VI.

*Type Material.* The lectotype male of *menuachus* Cresson from New Mexico is in the collection of the Philadelphia Academy of

TABLE VI. Summary of Floral Records for *Melissodes menuachus*.

Plant Data			Records of <i>M. menuachus</i>			
FAMILY	Number of genera	Approximate number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae: <i>Grindelia</i> spp.	1	2	31	39	30	69
Compositae: <i>Solidago</i> spp.	1	3	14	17	6	23
Other Compositae	9	13	18	15	20	35
Leguminosae	3	3	7	3	4	7
Brassicaceae	1	1	6	0	9	9
Others (5)	5	5	8	2	8	10
Totals	20	27	84	76	77	153

Sciences. The holotype female of *pallida* Robertson, collected by Robertson (Coll. No. 9619) September 26, 1890, on *Helianthus grosse-serratus*, is in the collection of the Illinois Natural History Survey, Urbana. The holotype female of *mizeae* Cockerell, collected by Mize at Las Vegas, N. Mex., in August on *Grindelia inornata*, is in the collection of P. H. Timberlake, Citrus Experiment Station, Riverside, California. The holotype female of *blakei* Cockerell, collected at Beulah, N. Mex. in August, is in the collection of the U. S. National Museum (Type No. 40094). The female holotype of *lavata* Cockerell, collected at Wray, Colo., August 17-19, 1919, by F. Lutz, is in the collection of the American Museum of Natural History, New York City. The holotype female of

*octobris* Cockerell, collected at Hudson, Colo., October 1, 1933, is in the collection of P. H. Timberlake, Citrus Experiment Station, Riverside, California.

*Distribution.* This species is widely distributed from British Columbia, Alberta and North Dakota, east to Illinois and south to north-central Mexico and Texas (Fig. 14). It has been reported from Camden Co., New Jersey, by Smith (1910), but this is probably in error. It is most abundant in the prairie regions of Colorado, Nebraska and Kansas. *M. menuachus* has been taken from July 2 to October 6, but mainly in August and September. In addition to the types, a total of 245 females and 209 males from the localities listed below have been examined. This list includes localities reported in the literature.

ARIZONA: Bisbee (12 miles W.); Chiricahua Mts.; Flagstaff (and 7 miles S. and 4 miles N.); Mt. Graham; Grand Canyon;

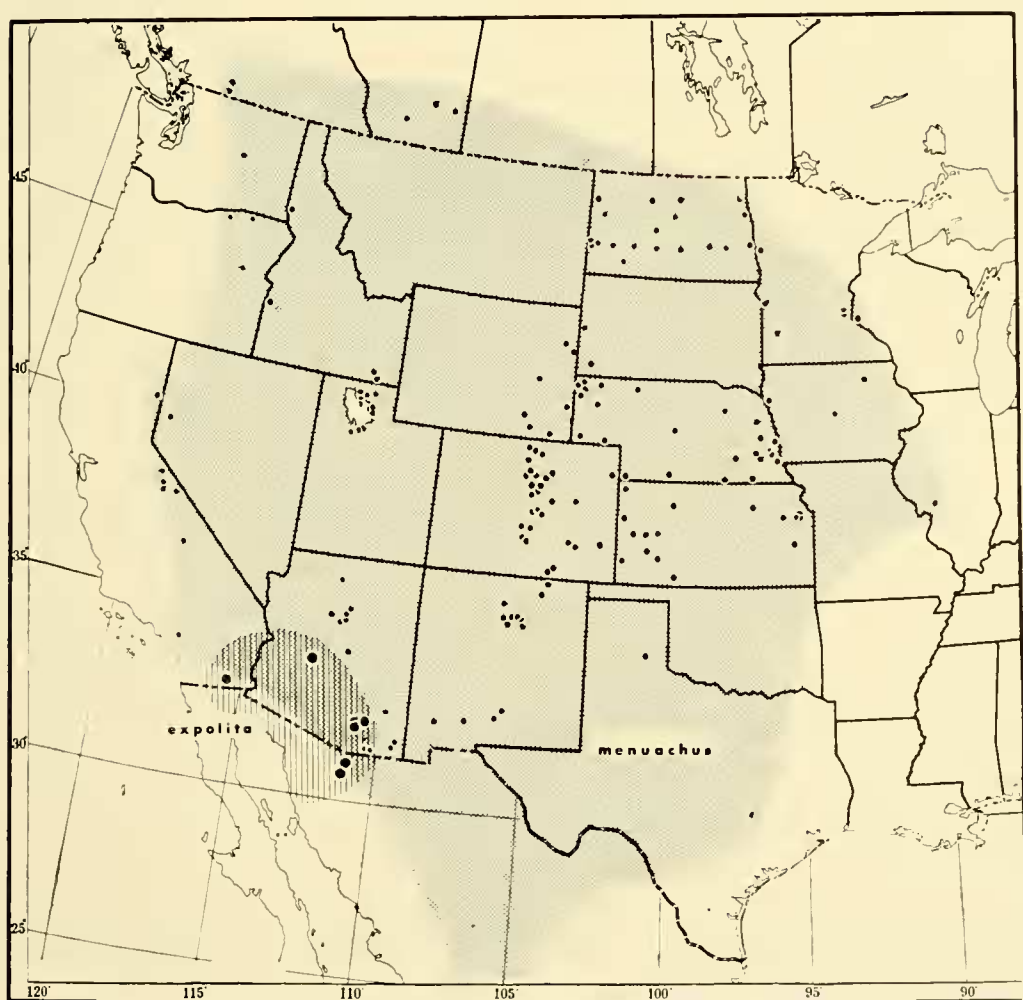


FIG. 14. Map showing the known distributions of *M. (Eumelissodes) menuachus* Cresson and *M. (E.) expolita* LaBerge.



Huachuca Mts.; Lochiel (4 miles E.); Payson; Sedona (10 miles N.); Southwest Research Station (5 miles W. of Portal); Williams. CALIFORNIA: Amedee, Lassen Co.; Benton's Crossing, Mono Co.; Bridgeport, Mono Co.; Grant Lake, Mono Co.; Mono Lake; Owen's Valley; Riverside. COLORADO: Boulder; Brighton; Buffalo Creek; Canon City; Chimney Gulch (near Golden); Colorado Springs; Custer Co.; Denver; Elbert; Eldora; Estes Park; Florissant; Fort Collins; Fremont Co.; Garden of the Gods (near Colorado Springs); Hoehne; Hudson; Jim Creek, Boulder Co.; La Junta; Lamar; Larimer Co.; Limon; Pingree Park; Platte Canyon (near Waterton); Poudre Canyon (W. of Fort Collins); Red Wash; Rock Creek (near Colorado Springs); Rocky Ford; Trinidad; West Cliff, Custer Co.; Wray. IDAHO: Downey; Franklin; Lewiston; Parma. ILLINOIS: Carlinville. IOWA: Ames; Chickasaw Co.; Sioux City. KANSAS: Baldwin; Cheyenne Co.; Clark Co.; Douglas Co.; Garden City; Garnett; Grant Co.; Hill City; Johnson (2 miles N.); Lane Co.; Lawrence; Riley Co.; Scott City (5 miles N.); Topeka; Wallace Co.; Wichita Co. MINNESOTA: Lyon Co.; Moorhead; Ortonville; Powder Plant Woods, Ramsey Co.; St. Paul. MONTANA: "Mon." NEBRASKA: Ashland; Box Butte Co.; Cambridge; Cedar Bluffs; Glen, Sioux Co.; Gordon; Haigler; Hardy; Harrison; Kimball; Lincoln; Lodgepole; Malcolm; McCool; Monroe Canyon, Sioux Co.; Nebraska City; Neligh; North Platte (8 miles W.); Omaha; Sand Hills, Cherry Co.; Sioux Co.; Steele City, Jefferson Co.; South Bend; West Point. NEVADA: Pyramid Lake. NEW MEXICO: Beulah; Embudo; Glorieta; Hurley (5 miles S.); Las Vegas; Maxwell City; Mescalero; Raton; Rincon; Rito de los Frijoles; Roziata; Tularosa Creek; Santa Fé; Sapello; Sapello Canyon. NORTH DAKOTA: Beach; Dickinson; Fargo; Glenn Ullin; Grafton; Grand Forks; Jamestown; Mandan; Martin; Medora; Minot; Mott; Rugby; Schaffer; Sentinel Butte; Steele; Valley City; Washburn; Williston. OREGON: Echo; Freewater; Hereford. SOUTH DAKOTA: Deadwood; Hot Springs. TEXAS: Clarendon; Fedor, Lee Co. UTAH: Bear River City; East Promontory; Grantsville; Kaysville; Lake Point; Logan; Magna; Ogden; Promontory. WASHINGTON: Coulee City. WISCONSIN: Prescott. WYOMING: Albany Co.; Cheyenne; Clifton, Weston Co.; Douglas; Laramie; Torrington; Weston Co. *Canada*. ALBERTA: Lethbridge; Medicine Hat; Scandia. BRITISH COLUMBIA: Penticton; Similkameen. *México*. CHIHUAHUA: Aguascalientes (Sta. Barbara Dist.); Salaíces. ZACATECAS: Sain Alto.

*Flower Records.* *Argemone* sp., *A. intermedia*, *A. platyceras*, *Aster* sp., *A. laevis*, *A. multiflora*, *Cassia chamaecrista*, *Chrysopsis*

sp., *Chrysothamnus* sp., *C. graveolus glabrata*, *Cleome* sp., *C. serrulata*, *Eustoma russellianum*, *Gaillardia* sp., *Grindelia* sp., *G. inornata*, *G. squarrosa*, *Gutierrezia* sp., *G. californicum*, *G. sarothrae*, *Helianthus* sp., *H. annuus*, *H. petiolaris*, *Hymenothrix wislizenia*, *Medicago sativa*, *Melilotus* sp., *M. alba*, *Petalostemum oligocephalum*, *Polygonum* sp., *Rudbeckia laciniata*, *Sidalcea neomexicana*, *Solidago* sp., *S. canadensis*, *S. rigida*, *Verbena* sp., *Viguiera* sp., *Xanthocephalum gymnospermoides*.

*Melissodes (Eumelissodes) semilupina* Cockerell

*Melissodes menuacha semilupina* Cockerell, 1905, Bull. S. California Acad. Sci., vol. 4, p. 29.

*Melissodes chrysothamni* Cockerell, 1905, Ann. Mag. Nat. Hist., ser. 7, vol. 15, p. 524, (new synonymy); 1906, Trans. Amer. Ent. Soc., vol. 32, p. 85; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309.

*Melissodes mizeae*, Cockerell, 1912, Ann. Mag. Nat. Hist., ser. 8, vol. 10, p. 448 (misidentification).

This species is a large bee closely related to *M. menuachus* Cresson. The female of *semilupina* agrees with *menuachus* in having a relatively long second flagellar segment. It differs, however, in lacking the pale lateral tufts of hairs on terga 6 and 7 and in having brown hairs on the anterior and lower-lateral parts of the mesepisterna and coxae. The male of *semilupina* resembles that of *menuachus* closely but has a distinct band of long, pale, appressed pubescence covering the apical margin of the first tergum.

*Female.* Measurements and ratios: N, 20; length, 13-16 mm.; width, 4.5-6.0 mm.; wing length,  $M = 4.70 \pm 0.247$  mm.; hooks in hamulus,  $M = 18.10 \pm 0.240$ ; flagellar segment 1/segment 2, (19)  $M = 1.91 \pm 0.024$ .

Structure and color: Integumental color as in *menuachus* except as follows: eyes grayish blue; second (often third) flagellar segment totally black, segments 3 to 10 usually dark red below; tegulae piceous; wing veins dark brown; apical areas of terga usually black, occasionally dark reddish brown.

Structure and sculpturing as in *menuachus* except as follows: length of second flagellar segment occasionally equal to width, usually slightly longer; maxillary palpal ratio about 4.5:4.0:3.5:1.0; clypeus relatively flat, lateral angle separated from eye margin by less than half minimum diameter of first flagellar segment, with median boss near apex but not usually carinate; supraclypeal area shiny, unshagreened, impunctate or punctures sparse and minute; lateral flattened areas of vertex with small punctures separated by one or less puncture widths, shiny. Mesoscutum with large, deep, round, variable-sized punctures, in posteromedian area separated

mostly by one puncture width or slightly more, surface often slightly dulled by reticular shagreening; mesepisterna moderately shiny, surface somewhat dulled by coarse, reticular shagreening. Metasomal tergum 1 with punctures of basal three-fifths small, shallow, separated mostly by one to one and one-half puncture widths, surface dulled by dense, reticulotransverse shagreening; terga 2 and 3 with interband zone punctures scarcely broader than base of hairs arising from them, separated mostly by two to three puncture widths or more, surface dulled by dense reticular shagreening, apical areas moderately shiny, impunctate.

Hair: Color as in *menuachus* except as follows: labrum and mandible often brown; anterior and lower lateral surfaces of mesepisterna dark brown; tergum 2 with interband zone hairs appressed to suberect, long, distal and basal pale bands confluent laterally and medially; tergum 3 with apical area usually as long as half width of distal pale band, with suberect, relatively simple, white or brown hairs; terga 5 and 6 without lateral pale tufts; sterna dark brown; legs as in *menuachus* but coxae dark brown, usually femora and trochanters dark brown at least below and occasionally entirely so; fore and middle distitarsi and basitarsi dark brown; hind basitarsi with inner surfaces and scopal hairs at apices of outer surfaces dark brown.

*Male.* Measurements and ratios: N, 20; length, 12-15 mm.; width, 3.5-5.5 mm.; wing length,  $M = 4.36 \pm 0.212$  mm.; hooks in hamulus,  $M = 15.10 \pm 0.176$ ; flagellar segment 2/segment 1,  $M = 4.24 \pm 0.064$ .

Structure and color: Integumental color as in *menuachus* except as follows: first flagellar segment usually dark brown or black, rarely red or yellow below; eyes brownish yellow to green; tegulae testaceous; wing veins red to reddish brown.

Structure as in *menuachus* except as follows: minimum length first flagellar segment equals one-fifth or slightly more of maximum length second segment, flagellum slightly crenulate near apex in lateral view (segments 9 and 10, and often 7 and 8, somewhat constricted below near base); maxillary palpal ratio about 3.0:2.7:2.3:1.0. Sculpturing as in female except as follows: tergum 1 with basal five-sixths with small round punctures mostly separated by one to two puncture widths, surface dulled by dense reticular shagreening, apical area beneath apical pale pubescent band with minute punctures and dulled at least basally; terga 2-4 with interband zone punctures minute, separated mostly by two to three puncture



widths, surface dulled by dense reticulotransverse shagreening, apical areas moderately shiny, impunctate; terga 5 and 6 similar but punctures more crowded.

Sterna 7 and 8 and genital capsule as in *menuachus* but sternum 7 with median plate with ventral hairs stouter (especially near base of plate).

Hair: Vestiture essentially as in *menuachus* but dull white rather than ochraceous and never bright ochraceous on dorsum of thorax or vertex of head.

*Bionomics.* This species is an oligolege of the composite genus *Chrysothamnus*. Females have been collected only from flowers of that genus (as far as the collection labels indicate), and males have been collected more often on *Chrysothamnus* flowers than on all other plants together. Isolated males, however, have been taken on *Solidago*, *Isocoma* and *Cleome* flowers and several were collected on sugar beets (whether on the inflorescence or on the harvested beets is not clear, but I suspect the latter).

*Type Material.* The male holotype of *semilupina* collected by Dr. A. Davidson at Los Angeles, California, is in the collection of the Natural History Museum of the University of Colorado at Boulder. The female holotype of *chrysothamni* collected at Embudo, New Mexico, September 16, 1897, by T. D. A. Cockerell on *Bigelovia* (= *Chrysothamnus*) sp. is in the collection of the U. S. National Museum (Type No. 40093).

*Distribution.* *M. semilupina* ranges from British Columbia and the Pacific Coast States east to Colorado and New Mexico (Fig. 13). It is most abundant in Oregon and California. This species has been collected from August 5 to October 29, but chiefly in September. In addition to the holotype, 22 females and 89 males have been examined from the localities listed below (including records reported in the literature).

ARIZONA: Tucson. CALIFORNIA: Adelanto (8 miles S.), Mohave Desert; Anaheim; Deep Creek; Fort Tejon; La Jolla; Los Angeles; Los Angeles Co.; Morro Bay; Oro Grande; Riverside; San Diego Co.; Standish, Lassen Co.; Truckee (11 miles E. at Boca Dam); Victorville. COLORADO: Alamosa; Great Sand Dunes National Monument. NEVADA: Sparks, Washoe Co.; Sutcliffe, Washoe Co. NEW MEXICO: Embudo; Abbotts Ranch, Rito de las Frijoles. OREGON: Arlington; Bend; Echo; Sisters (and 5 miles E.); Tumalo. UTAH: Emery Co.; Iosepa; Juab Co.; Lehi; Park Valley. WASHINGTON: Hunts Junction; "Wash. Terr." WYOMING: Granger.

Canada. BRITISH COLUMBIA: Oliver; Vernon; Wallhackin. ALBERTA: Magrath.

*Flower Records.* *Chrysothamnus* sp., *C. nauseosus*, *Cleome* sp., *Isocoma* sp., *Solidago occidentalis*.

*Melissodes (Eumelissodes) ochraea*, n. sp.

This species is closely related to both *menuachus* and to *semilupina*. The female is similar to that of *menuachus* in having tufts of pale hairs laterally on terga 5 and 6 and by having pale hairs on the lower lateral and anterior parts of the mesepisterna. However, the female of *ochraea* has the second flagellar segment distinctly shorter than broad, has a slightly more densely punctate mesoscutum than either *menuachus* or *semilupina*, and lacks suberect hairs in the apical area of tergum 3. The male of *ochraea* resembles that of *semilupina* in the form of the first flagellar segment and in having the dense, apical, pale pubescent band on the first tergum. It can be distinguished from *semilupina* by the more densely punctate mesoscutum.

The female of *ochraea* also resembles the female of *submenuacha* very closely. However, the males of these two species are quite distinct and the resemblance of the females does not, perhaps, indicate close relationship. The female of *ochraea* can be distinguished from that of *submenuacha* by the almost total lack of suberect hairs in the apical area of terga 2 and 3, by the dark brown hairs of terga 5 and 6 and of the sterna. The male of *ochraea* differs from that of *submenuacha* in the much longer first flagellar segment.

*Female.* Measurements and ratios: N, 20; length, 11-15 mm.; width, 3.5-5.0 mm.; wing length,  $M = 4.33 \pm 0.171$  mm.; hooks in hamulus,  $M = 16.60 \pm 0.222$ ; flagellar segment 1/segment 2,  $M = 2.12 \pm 0.035$ .

Structure and color: Integument black except as follows: apical half of mandible, often apical margin of clypeus, distitarsi, often basitarsi and occasionally rest of leg, and sterna rufescent; eyes gray; wing membranes colorless or slightly milky, veins reddish brown to black; tegulae piceous; tibial spurs yellow.

Clypeus flat, margin separated from eye by less than half minimum diameter of first flagellar segment, with median carina in apical half; maxillary palpal ratio about 4.5:2.5:3.0:1.0, (in one paratype from Whitewater, California, a distinct fifth segment equal in length to fourth is present); clypeus with round, shallow, coarse punctures separated mostly by less than half a puncture width, surface (and

bases of punctures) somewhat dulled by coarse, reticular shagreening; galeae above shiny, slightly dulled in apical half or less by reticular shagreening; vertex with lateral flattened areas with small punctures of irregular size separated mostly by half to two puncture widths, surface shiny. Thoracic sculpturing as in *menuachus* but mesoscutum with posteromedian area punctures separated mostly by less than one puncture width and often dulled by delicate reticular shagreening, scutellum shiny and punctures crowded, mesepisterna shiny, shagreening, if present, extremely delicate. Tergal punctation as in *semilupina*; terga 1-3 with apical areas impunctate, shiny, reticulotransverse shagreening extremely fine. Pygidial plate V-shaped, with apex more pointed than in *submenuacha*, *menuachus* or *semilupina*.

Hair: Head and thorax ochraceous, paler on clypeus, frons, genal areas, sides of thorax, and propodeum, often much brighter on vertex and dorsum of thorax (even being orangish here in some specimens but dark ochraceous in holotype). Metasomal pale pubescence and hairs pale ochraceous; tergal vestiture as in *menuachus* except as follows: tergum 3 with distal pale band separated from apical margin across entire tergum, apical area glabrous, without suberect hairs except occasionally a few at extreme base of area near pale band, medially apical area at least as long as pale band. Leg hairs as in *menuachus* except inner surfaces of hind basitarsi often reddish brown (as in holotype) and occasionally red.

*Male.* Measurements and ratios: N, 14; length, 12-14 mm.; width, 3-4 mm.; wing length,  $M = 4.06 \pm 0.216$  mm.; hooks in hamulus,  $M = 13.86 \pm 0.231$ ; flagellar segment 2/segment 1, (13)  $M = 4.31 \pm 0.134$ .

Structure and color: Integument black except as follows: clypeus and base of mandible yellow; labrum cream-colored except brown apical margin; flagellum yellow to red below (except first segment), reddish brown to black above; eyes gray to green; distitarsi and sterna rufescent; wing membranes colorless, veins red to reddish brown; tegulae testaceous (allotype) to piceous; apical areas of terga hyaline, colorless to slightly yellow.

Structure as in *menuachus* except as follows: minimum length of first flagellar segment equals one-fifth or more (more in allotype) of maximum length second segment; maxillary palpal ratio about 4.0:3.5:3.5:1.0, minute fifth segment sometimes present; clypeus flat. Sculpturing as in female except as follows: metasomal tergum 1 with basal five-sixths or more punctate, apical area beneath apical



pale band with minute punctures; terga 2, 3 and 4 with more distinct interband zone punctures separated mostly by about two puncture widths.

Sterna 7 and 8 and genital capsule as in *menuachus* but hairs on gonostylus shorter, sparser, never bifid or trifid at apex and hairs of ventral surface of median plate of sternum 7 sparse and weak.

Hair: Head and thorax pale ochraceous to white, often somewhat darker on vertex and dorsum of thorax (pale in allotype). Metasomal vestiture as in *menuachus* except as follows: tergum 1 with apical pale band of long, appressed, plumose hairs hiding surface across entire tergum (unless worn); terga 2-4 with apical areas without suberect hairs except one or two rows limited to base of apical area near pale pubescent bands. Legs white to pale ochraceous except inner surfaces of tarsi yellow.

*Type Material.* The holotype female and allotype male from Whitewater, Riverside Co., California, October 27, 1934, were collected by C. D. Michener on *Isocoma acradenia*. Nineteen female and nine male paratypes from California are as follows: Whitewater: 1 female with the holotype; 5 females and 1 male on *I. acradenia*, October 27, 1934, P. H. Timberlake; 3 females and 2 males, October 27, 1934, A. L. Melander; 2 females on *I. acradenia*, November 12, 1932, P. H. Timberlake; 1 female, September 8, 1949. Indio: 3 males, October 13, 1935, E. G. Linsley; 1 male on *I. acradenia*, October 15, 1947, P. H. Timberlake; 1 male on *I. acradenia* (2.8 miles S. E.), October 23, 1951, P. H. Timberlake. Morongo Valley: 1 male on *Gutierrezia* sp., September 26, 1944, P. H. Timberlake. Vallecito, San Diego Co.: 7 females, September 24, 1936, C. M. Dammus. The holotype and allotype are in the Snow Entomological Collection of the University of Kansas, Lawrence. Paratypes are in the collections of the University of Kansas, P. H. Timberlake of the Citrus Experiment Station, Riverside, California, the University of California at Berkeley, Harvard University (Museum of Comparative Zoology), and in the author's collection.

*Distribution.* Southern California and Arizona (Fig. 10). Since only 13 specimens are known in addition to the type material, the data for these are listed below in full.

ARIZONA: Madera Canyon, Santa Rita Mts.: 1 male, October 4, 1956, G. D. Butler and F. G. Werner. Rosemont, Pima Co.: 1 female on *Baccharis* sp., October 9, 1954, F. G. Werner. Sabino Basin, Santa Catalina Mts.: 1 male, September 28, C. H. T. Townsend. Safford: 2 females on yellow composite, September 24, 1956, G. D.

Butler; 2 females on yellow composite (30 miles S.), September 24, 1956. Tucson: 1 female, October 20, 1919; 1 male, October 1927, J. A. Downes; 1 female, October 8, 1937, R. H. Crandall; 1 female, September 29, 1939, A. S. Rosenberg; 1 female, November 10, 1939, A. S. Rosenberg.

*Melissodes (Eumelissodes) bimatrix*, n. sp.

This species is highly variable in the color of the vestiture and is closely related to *semilupina* and *ochraea*. Females, because of their color variation, are difficult to separate from the latter two species, especially if they have much of the pubescence worn away. The female is like *semilupina* in having suberect hairs in the apical areas of terga 2 and 3, but the second flagellar segment is usually distinctly broader than long ventrally. The female also differs from *semilupina* females in the sculpturing of the interband zones of terga 2 and 3, as described below, and in the erect hairs in these zones. The female can be readily distinguished from that of *ochraea* by the punctation of the mesoscutum and the first metasomal tergum, and by the erect hairs of the interband zones of terga 2 and 3. The males are readily distinguished by lacking yellow maculae at the mandibular base, by the labrum being all or mostly black, and by the sparse mesoscutal punctures. The darkest females resemble *M. (Callimelissodes) nigracauda* from which they differ by the shiny galeae and pale scopal hairs.

*Female*. Measurements and ratios: N, 20; length, 11-15 mm.; width, 4.0-5.5 mm.; wing length,  $M = 4.10 \pm 0.150$  mm.; hooks in hamulus,  $M = 14.75 \pm 0.298$ ; flagellar segment 1/segment 2,  $M = 1.96 \pm 0.022$ .

Structure and color: Integument black except as follows: apical half of mandible, often distitarsi, and flagellar segments 3-10 below rufescent; eyes gray; wing membrane colorless to slightly milky; veins dark reddish brown to black; tegulae piceous; tibial spurs colorless to pale yellow. Apex of tergum 1 narrowly hyaline.

Clypeus relatively flat, lateral angle separated from eye margin by half minimum diameter first flagellar segment or less, with median longitudinal carina usually present; second flagellar segment slightly broader at apex than median ventral length; maxillary palpal ratio about 3.0:2.7:2.3:1.0; galeae shiny, unshagreened above except perhaps delicately so in apical half or less. Sculpturing of head and thorax as in *ochraea* except posteromedian mesoscutal punctures separated mostly by more than one puncture width and often by two

or more puncture widths, surface unshagreened. Tergal sculpturing as in *menuachus* except as follows: tergum 1 with basal two-thirds or more (medially) punctate, punctures shallow, separated by one-half to one and one-half puncture widths and reaching apical margin at extreme sides, impunctate apical area not expanded basally at sides into impunctate lateral lobes; tergum 2 with interband zone punctures minute, separated by one to three puncture widths; terga 2 and 3 with apical areas with minute punctures at least basally near distal pale bands. Pygidial plate broadly V-shaped with well-rounded apex, usually less than eight-tenths as broad at base as median length.

Hair: Head pale ochraceous to entirely black, dark hairs appear first on labrum and mandibles, second on clypeus and vertex from which areas they spread over entire head in darker specimens. Thorax pale ochraceous to white laterally and posteriorly and dull ochraceous to somewhat rufescent above in palest specimens; in darkest specimens lateral and posterior surfaces, propodeum, tegulae, and anteriorly on mesoscutum dark brown to black, remainder of dorsum pale ochraceous to pale rufescent, posteromedian area of mesoscutum and median area of scutellum without dark hairs; intermediate specimens with entire dorsum, entire propodeum and upper lateral surfaces pale. Metasoma of palest specimen as in *ochraea* except as follows: interband zone of tergum 2 with hairs erect and without suberect or appressed plumose hairs; tergum 2 with distal pale band well separated from basal band except at extreme sides; tergum 4 with distal pale band narrow, medially narrower than basal area of dark hairs; terga 5 and 6 with little or no pale hairs laterally. Darkest specimens with metasomal vestiture entirely dark brown to black; pale hairs appear first at extreme base of tergum 2, second at base of tergum 1 and in distal pubescent band of tergum 2, third on tergum 3, and lastly on succeeding terga. Tergum 1 with long apical hairs of basal area appressed and reaching or overpassing margin across entire tergum whether these dark or pale (often worn away medially, however). Legs as in *ochraea* in pale specimens; in dark specimens dark brown to black except as follows: scopal hairs (except surrounding pygidial plate and at apex of basitarsus) ochraceous to yellow, inner surface hind tibiae ochraceous to yellow, hind femora often paler above, inner surface hind basitarsus dark brown to black.

*Male.* Measurements and ratios: N, 20; length, 10-14 mm.; width, 3.0-4.0 mm.; wing length,  $M = 3.88 \pm 0.167$  mm.; hooks in hamulus,



$M = 13.30 \pm 0.219$ ; flagellar segment 2/segment 1,  $M = 4.68 \pm 0.089$ .

Structure and color: Integument as in *menuachus* except as follows: base of mandible black; labrum entirely black (allotype) or with small mediobasal pale spot; clypeus yellow with apical margin usually piceous; first flagellar segment dark brown; eyes gray to green; wing veins dark reddish brown to black; tegulae piceous. Structure as in *menuachus* except as follows: minimum length first flagellar segment one-fifth or less (less in allotype) maximum length second segment, penultimate 3 or 4 segments slightly crenulate (as in *semilupina*); maxillary palpal segments in ratio of about 4.0:3.5:3.5:1.0. Sculpturing as in female except as follows: metasomal tergum 1 with more than basal five-sixths (medially) punctate; terga 2 and 3 with punctures usually slightly coarser and more crowded.

Sterna 7 and 8 and genital capsule as in *M. menuachua* except gonocoxite without ventral hairs just below gonostylus.

Hair: Head and thorax white to pale ochraceous, often somewhat darker ochraceous on vertex of head and dorsum of thorax. Metasomal vestiture as in *ochraea* except distal pale bands of terga 2-4 (especially tergum 2) usually narrower than apical apubescent area; terga 2-4 with apical areas with abundant suberect pale hairs; tergum 2 with interband zone hairs erect; tergum 1 with distinct band of pale appressed pubescence obscuring apical margin across entire tergum. Two specimens (one from Santa Ana River, San Bernardino County and the other from Long Barn, Tuolumne County, California) with hairs and pubescence yellow-ochre to pale rufescent and brownish red in basal areas of terga 3 to 5. Legs as in *ochraea*.

*Remarks.* This species is very remarkable because of the marked dimorphism in color of the females. This is not reflected in the males. The females present two distinct color patterns in the vestiture. These two extremes are described above. There are intermediate specimens, but these are relatively few in number. Out of a total of 173 females, 96 were classified as the darkest form, 73 as the pale form, 7 as almost perfectly intermediate, 14 as intermediate but nearer the dark form, and 9 as intermediate but near the pale form.

It seems likely that a single pair of alleles, or a very few loci, are involved in the genetic background of this dimorphism. The intermediate types could be explained by microclimate affecting the rate of development and thus affecting melanism deposition during the prepupal or pupal stages of development. Significant in this respect

is the fact that there are so very few intermediate specimens and the majority of these are more like one or the other of the extremes in color than they are like the few almost exact intermediates. Furthermore, the dimorphism follows no apparent geographical pattern. Both forms of females and intermediates are available from such widely separated areas as Utah, Nevada, and northern and southern California. During preliminary studies, the author had segregated the females as two distinct species. There remains a possibility that this is the true situation. However, with the accumulation of additional specimens intermediate forms have become available. Furthermore, the two extreme forms, plus intermediates, have been collected in several instances at the same time, from the same flowers, and with the same males.

*Bionomics.* This species is apparently oligolectic on Compositae and, in particular, upon the genus *Chrysothamnus*, as is its close relative *M. semilupina*. Out of a total of 72 collections (93 females and 51 males) with floral data attached, 53 collections (80 females and 41 males) were made from some species of *Chrysothamnus*, whereas only 19 collections (13 females and 10 males) were obtained from other composites representing 11 genera.

*Type Material.* Holotype female (pale form) and two female paratypes (one an intermediate form) collected by E. G. Linsley on *Chrysothamnus nauseosus speciosus*, September 7, 1957, from 8 miles S. of Ravendale, Lassen Co., California. Allotype male from 15 miles S. of Ravendale was collected by B. J. Adelson on *Chrysothamnus nauseosus consimilis*, September 7, 1957. The holotype and allotype are in the collection of the University of California at Berkeley. Five male and twenty-seven female paratypes from California are as follows: LASSEN CO.: Depau: 2 females, October 11, 1952, E. I. Schlinger. Hallelujah Junction: 1 female on *Chrysothamnus nauseosus consimilis*, (2.5 miles S.), September 6, 1957, E. G. Linsley; 1 female on *C. n. consimilis*, (6 miles N.) B. J. Adelson. Janesville (1 mile N.): 1 female on *C. n. speciosus*, September 8, 1957, B. J. Adelson; 3 females on *C. n. speciosus*, September 8, 1957, E. G. Linsley. Litchfield: 2 males on *C. v. viscidiflorus*, September 8, 1957, E. G. Linsley. Madeline (8 miles N.): 1 female on *C. n. speciosus*, September 7, 1957, J. A. Chemsak. Standish (4 miles W.) 1 female on *C. v. viscidiflorus*, September 7, 1957, E. G. Linsley. MODOC CO.: Alturas (8 miles N.): 1 female and 1 male, September 7, 1957, J. A. Chemsak. Cedar Pass: 8 females and 1 male, October 11, 1952, E. I. Schlinger. Juniper Flat: 1 female, July 1938, J. J. DuBois.

Mason Creek Railroad Siding: 4 females, October 12, 1952, E. I. Schlinger. NEVADA CO.: Hobart Mills (7 miles N.): 1 female on *Chrysothamnus* sp., August 26, 1948, P. D. Hurd. Truckee (11 miles E. at Boca Dam): 1 female, September 15, 1957, E. G. Linsley. SIERRA CO.: Sierraville (3 miles N. W.): 1 female and 1 male on *Chrysothamnus* sp., September 9, 1957, E. G. Linsley. Twenty-nine male and four female paratypes from Washoe County, Nevada, are as follows: Purdy: 1 female on *Chrysothamnus* sp., September 6, 1957, E. G. Linsley; 1 female on *C. n. consimilis*, September 6, 1957, B. J. Adelson. Reno: 1 female and 1 male from 2 miles N., September 6, 1957, E. G. Linsley; 1 female from 7 miles N. on *C. n. consimilis*, September 6, 1957, J. A. Chemsak. Sparks: 1 male from 12 miles N. on *Chrysothamnus* sp., September 2, 1957, E. G. Linsley; 21 males from 17 miles N. on *C. n. consimilis*, September 2, 1957, E. G. Linsley. Sutcliffe: 2 males on *Chrysothamnus* sp., 4 males without floral data, September 2, 1957, E. G. Linsley. Paratypes are in the collections of the University of California at Berkeley and at Davis, R. R. Snelling, Turlock, California, the Snow Entomological Museum of the University of Kansas at Lawrence, and in the author's collection.

*Distribution.* *M. bimatrix* ranges from British Columbia south to southern California and east to Colorado and New Mexico (one eastern Colorado male is dubiously identified as *bimatrix*, although it is in very poor condition (Fig. 12). It has been collected from June to November 8, but mainly during September. In addition to the type material, 148 females and 73 males have been examined from the localities listed below.

ARIZONA: Black Mesa (near Kayenta); Pearce; Safford (30 miles S.); Tombstone (E. of); Yuma. CALIFORNIA: Apple Valley, San Bernardino Co.; Barton Flatts; Caliente Mt. (2 miles N. E.), San Luis Obispo Co.; Carbon; Carmel; Deep Creek, Mojave Desert; Democrat Springs, Kern Co.; Gazelle; Helendale; Hesperia, S. Bernardino Co.; Imperial Co.; Lancaster (2 miles N.); Little Lake, Inyo Co.; Livermore (20 miles S. at Arroyo Mocho); Long Barn, Tuolumne Co.; Los Angeles Co.; McArthur; Morongo Valley; Murphys; Olancho (13 miles S.); Oro Grande; Paynes Creek, Tehama Co.; Riverside; Santa Ana River, S. Bernardino Co.; Seven Oaks; Sonora Pass, Mono Co.; South Fork Camp, S. Bernardino Mts.; Tesla; Turlock; Victorville, Vincent; Westgard Pass, Inyo Co.; Whitewater. COLORADO: Berkeley; Cortez. IDAHO: Bliss, Conant; Parma; Ridge-dale. NEVADA: Eureka; Walker Lake, Mineral Co. NEW MEXICO:



McCartys, Valencia Co.; Mescalero. OREGON: Abert Lake; Algoma, Klamath Lake; Echo; Redmond. UTAH: Arches National Monument; Beryl; Blanding (19 miles W.); Dugway Proving Ground, Tooele Co.; East Promontory; Freemont Pass, Iron Co.; Lehi, Logan; Milford; Pine Valley Mts.; Promontory; Salt Lake; Torrey; Tridell. WASHINGTON: Brewster; Coulee City; Gardena; North Yakima; Pasco; Stratford. Canada. BRITISH COLUMBIA: Nicola; Oliver; Wallhackin. Mexico. SONORA: Agua Priete.

*Flower Records.* *Artemesia* sp., *Aster* sp., *Centromadia pungens*, *Chaematoris* sp., *Chrysothamnus* sp., *C. nauseosus*, *C. n. consimilis*, *C. n. gnaphalodes*, *C. n. mohavensis*, *C. n. occidentalis*, *C. n. speciosus*, *C. parryi*, *C. viridulus*, *C. viscidiflorus viscidiflorus*, *Ericameria palmeri*, *Eriogonum* sp., *Gutierrezia californica*, *G. lucida*, *G. sarothrae*, *Helianthus* sp., *Isocoma acradenia*, *Rhamnus californica*, *Senecio* sp.

*Melissodes (Eumelissodes) cerussata*, n. sp.

This species is known only from three females from San Bernardino County, California. These females resemble the females of *M. menuachus* in the shiny galeae, the long first flagellar segment, the dark hairs of the inner surfaces of the hind basitarsi, and in size, but differ in the generally white vestiture, the abundant, minute punctures in the apical area of tergum 3 and of tergum 2 (but less distinct in the latter). The female also resembles the palest female of *M. bimatrix*, but differs from the latter in the punctate tergal apices and the pale lateral tufts of hair on terga 6 and 7.

*Female.* Measurements and ratios: N, 3; length, about 13 mm.; width, about 4.5 mm.; wing length,  $M = 3.79 \pm 0.406$  mm.; hooks in hamulus,  $M = 15.67 \pm 0.882$ ; flagellar segment 1/segment 2,  $M = 188 \pm 0.058$ .

Structure and color: Integumental color as in *menuachus* except as follows: eyes gray; tergum 1 with apical area translucent, red to yellow; flagellar segments 3 to 10 and apex of 2 yellow below. Structure and sculpture as in *menuachus* except as follows: clypeal punctures small, round, surface dulled by tessellation; supraclypeal area with few punctures medially, surface moderately shiny, tessellate; second flagellar segment slightly longer than broad; maxillary palpal ratio about 4.0:3.4:2.8:1.0; lateral areas vertex with small round punctures separated by half to one or slightly more puncture widths, surface shiny but somewhat shagreened; mesoscutum with small impunctate posteromedial area, surface with

fine reticular shagreening scarcely dulled; metasomal tergum 1 with basal three-fourths with round punctures separated mostly by half to one puncture width, apical area impunctate, without anterolateral impunctate lobes; tergum 2 with basal area punctures separated mostly by half a puncture width or less, interband zone punctures small, separated mostly by one puncture width, surface dulled, apical area with minute but distinct punctures separated mostly by two to three puncture widths, surface moderately shiny; tergum 3 similar to 2 but apical area punctures more distinct and more crowded.

Hair: Head and thorax white except lower surfaces mesepisterna pale brown. Vestiture of metasomal terga as in *menuachus* except as follows: tergum 1 with basal area hairs white, apical area glabrous, basal hairs often reach apex of tergum medially; tergum 2 with all hairs and pubescence white, apical area hairs abundant, subappressed to suberect, white; tergum 3 like 2 but basal tomentum brown, apical area hairs more abundant, distal pale band reaches apex at extreme sides; tergum 4 like 3 but lacking apical area; terga 5 and 6 dark brown with white lateral tufts. Legs white except basitibial plates orange, fore tarsi and inner surfaces middle and hind basitarsi dark brown, and inner surfaces hind tibiae yellow.

*Type Material.* The holotype female from six miles west of Ludlow, San Bernardino Co., California, was collected October 17, 1951, on *Geraea* sp., by E. G. Linsley. Two female paratypes were collected at the same time and place on the same flower by P. D. Hurd and Ray F. Smith, respectively (see Fig. 10 for distribution). The holotype and one paratype are in the collection of the University of California at Berkeley. The second paratype is in the author's collection.

*Melissodes (Eumelissodes) relucens*, n. sp.

This species is closely related to *menuachus* and to *ochraea*. It is similar to *menuachus* in the color of the vestiture except that the females usually have paler hairs on the inner surfaces of the hind basitarsi. The females can be separated from those of *menuachus* and *ochraea* by the coarser punctation of the mesoscutum, the first tergum, and the interband and basal areas of the second tergum. The female has the second flagellar segment about as long as broad. The male of *relucens* has a short first flagellar segment and a long penultimate segment as in *menuachus*. The punctation of the male is similar to that of the female, but is much coarser

at the base of the second tergum and on the sterna. In addition, the male is distinctive in having an extremely broad pygidial plate.

*Female.* Measurements and ratios: N, 2; length, about 13 mm.; width, about 4.5 mm.; wing length, 3.74-3.79 mm.; hooks in hamulus, 13; flagellar segment 1/segment 2, 1.82-1.91.

Structure and color: Integument black except as follows: apical half of mandible, lower surfaces of flagellar segments except first, distitarsi, and sterna rufescent; eyes green; wing membrane colorless, veins dark brown to black; tegulae piceous; tibial spurs yellow to pale rufescent. Structure and sculpturing as in *menuachus* except as follows: clypeal punctures coarser, irregular in size, crowded, with subapical median shiny boss, surface shiny, unshagreened; supraclypeal area shiny; galeae above shiny, unshagreened; lateral areas of vertex with minute, sparse punctures, shiny; maxillary palpal ratio about 8:7:5:1. Mesoscutal punctures large, deep, round, crowded, posteromedially largest and separated mostly by half a puncture width or slightly more, surface with fine reticular shagreening but not or scarcely dulled; scutellum similar but punctures smaller; mesepisternal punctures small, round, deep, separated mostly by less than half a puncture width, mostly less in diameter than posteromedian mesoscutal punctures, surface shiny; propodeum with dorsal surface coarsely reticulorugose basally, with irregular punctures apically except medially, posterior surface punctate except upper inverted triangular area, lateral surfaces coarsely punctate, surfaces moderately shiny, upper triangle of posterior surfaces with fine, reticular shagreening slightly dulling surface. Tergum 1 with basal three-fifths medially with small round deep punctures separated mostly by half to one puncture width, punctures to apex laterally; terga 1-3 with apical areas impunctate, surfaces shiny with extremely fine reticulotransverse shagreening; tergum 2 with basal area with deep, small, round punctures separated mostly by half a puncture width or less, interband zone with small, irregular-sized and spaced punctures separated mostly by one puncture width; pygidial plate V-shaped with relatively straight sides and acute apex.

Hair: Color of vestiture as in *menuachus* except as follows: dorsum of thorax bright ochraceous to yellow and hairs short and appressed; metasomal pale pubescent bands white, that on tergum 2 not reaching apical margin and of almost equal width across tergum (not notched posteriorly as in *ochraea*), that on tergum



3 reaching apex at extreme sides; terga 2 and 3 with interband zone hairs white, short, appressed (unlike *bimatrix*); sterna reddish brown except white laterally; legs white except brown on fore tarsi and on basitibial plate, basitarsi with inner surfaces red to reddish brown.

*Male.* Measurements and ratios: N, 1; length, about 11 mm.; width, about 3.5 mm.; wing length, 3.63 mm.; hooks in hamulus, 12; flagellar segment 2/segment 1, 6.36.

Structure and color: Integument black except as follows: clypeus yellow except brown apical margin; labrum with minute pale mediobasal spot; base of mandible with minute yellow spot; eyes gray; lower surface of flagellum yellow, upper dark reddish brown; apical half of mandible, distitarsi and sterna rufescent; wing membrane colorless, veins dark reddish brown; tegulae piceous; tibial spurs reddish yellow; tergal apices hyaline, yellow; pygidial plate red.

Structure as in *menuachus* except as follows: minimum length first flagellar segment one-sixth of maximum length second segment or slightly less, penultimate segment almost four times as long as broad; maxillary palpal ratio about 14:12:7:1. Sculpturing as in female except as follows: tergum 1 with basal four-fifths punctate; tergum 2 with basal area punctures coarser than in female (in diameter almost equal to tergum 1 punctures); terga 2 and 3 with interband zone punctures coarser and more abundant; sternal punctures large and crowded. Pygidial plate broader than median length, deeply notched in apical third so that apical portion less than half as broad as broadest width near base.

Terminalia much as in *agilis* but median plates of sternum 7 with sparse hairs, gonostyli with hairs sparse, inner surfaces gonocoxites with blunt spicules sparse, and sternum 8 with apical hairs sparse and short.

Hair: Color and form of vestiture as in *menuachus* with same exceptions as in female.

*Type Material.* Holotype female and allotype male from Dugout Wells, Big Bend National Park, Texas, collected on August 25, 1954, by R. M. Bohart are in the collection of the University of California at Davis. One female paratype from El Paso, Texas, collected by H. V. Daly, September 13, 1950, on *Isocoma heterophylla* is in the collection of the Snow Entomological Museum of the University of Kansas at Lawrence (Fig. 15).

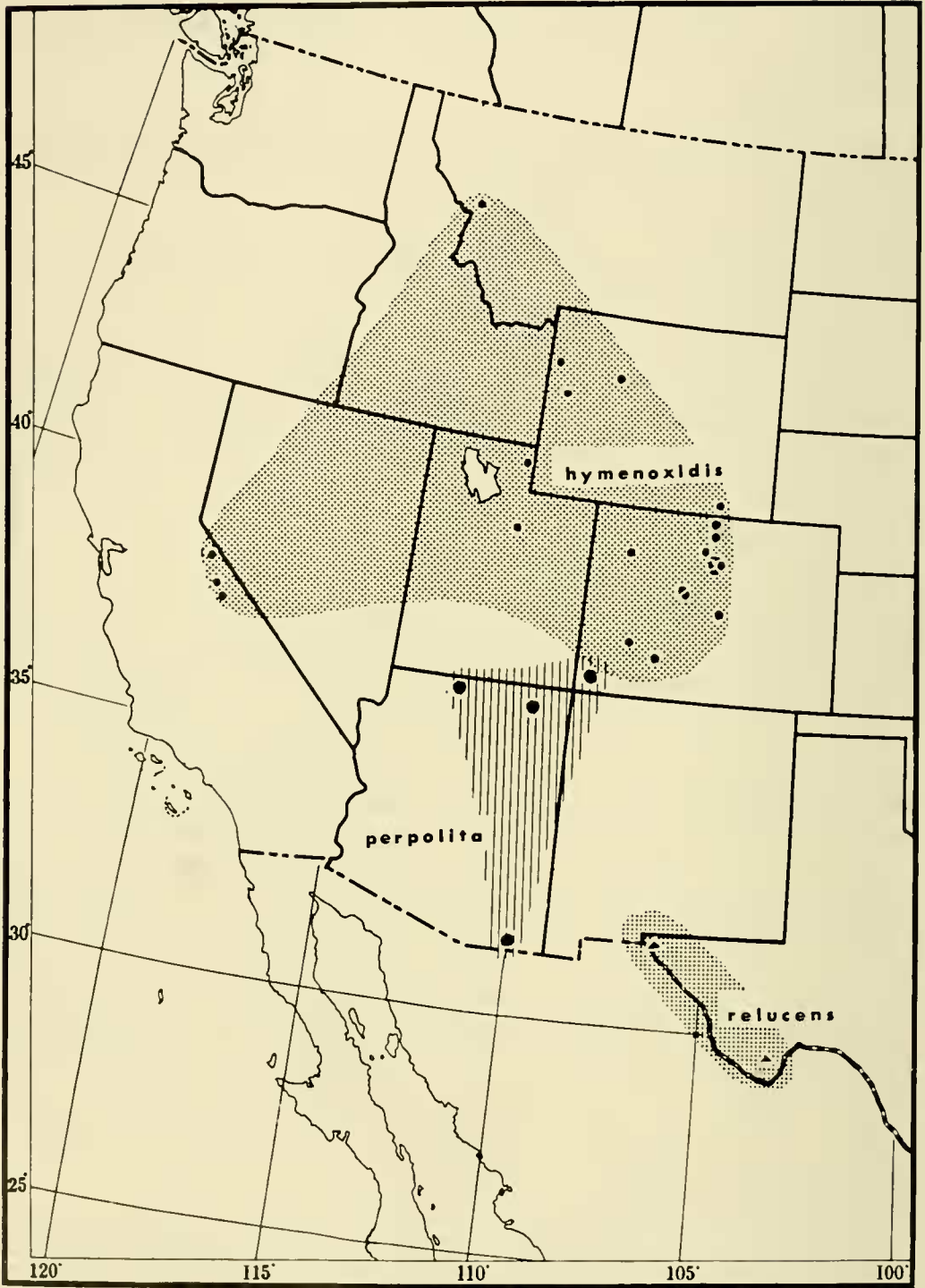


FIG. 15. Map showing the known distributions of *M. (Eumelissodes) hymenoxidis* Cockerell, *M. (E.) perpolita* LaBerge, and *M. (E.) relucens* LaBerge.

*Melissodes (Eumelissodes) bicolorata*, n. sp.

This species seems to be most closely related to *M. bimatrix* and the females of *bicolorata* closely resemble the darker females of *bimatrix*. However, the females of *bicolorata* have fuscous scopal hairs, unlike those of *bimatrix*. In the dark scopal hairs and general vestitural color, *bicolorata* is almost identical with *M. (Callimelissodes) nigracauda* from which it differs by the subgeneric characteristics and by having shiny, unshagreened galeae. The male of *bicolorata* is a medium sized, pale bee with pale wing veins not unlike *M. agilis* from which it differs by the dark labrum and mandibular bases. The male closely resembles that of *bimatrix* from which it can be distinguished by the lack of a distinct apical pale pubescent band obscuring the apex of the first tergum, by the pale wing veins, and by the flagellum not being crenulate (as it is in both *bimatrix* and *semilupina*).

*Female.* Measurements and ratios: N, 20; length 10-13 mm.; width, 3.5-4.5 mm.; wing length,  $M = 3.55 \pm 0.096$  mm.; hooks in hamulus,  $M = 14.50 \pm 0.212$ ; flagellar segment 1/segment 2,  $M = 1.96 \pm 0.024$ .

Structure and color: Integument black except as follows: apical half of mandible, usually distitarsus and lower surfaces of flagellar segments 3-10 rufescent; eyes dark gray to greenish gray; wing membranes slightly milky, veins reddish brown to red; tegulae piceous; tibial spurs yellow; apex of tergum 1 piceous.

Structure and sculpturing as in *bimatrix* except as follows: maxillary palpal ratio about 4.0:3.0:3.5:1.0; tergum 1 with basal three-fifths or less medially punctate, punctures not extending to apex laterally and impunctate apical area extending anterolaterally as indistinct lobes; tergum 2 with interband zone punctures minute and sparse; terga 2 and 3 with apical areas with punctures at bases of hairs minute and sparse but distinct and almost reaching apex of tergum at least laterally on tergum 2 and across entire tergum 3; pygidial plate broadly V-shaped with apex rounded, usually more than eight-tenths as broad at base as median length.

Hair: Head dark brown except long hairs of vertex and on face above and surrounding antennal fossae often pale ochraceous. Thorax above, including dorsal and posterior surfaces of propodeum and often mesepisterna and metepisterna just below wing bases, pale ochraceous to slightly ferrugineous (fox-red), laterally and ventrally dark brown to black. Metasoma dark brown to black except as follows: tergum 1 with basal half to three-fifths of dorsal surface pale



ochraceous (holotype) to slightly rufescent and tergum 2 with basal zone hairs often ochraceous to pale brown (dark in holotype). Legs dark brown except as follows: median scopal hairs of tibiae and occasionally near base of basitarsi usually paler brown to ochraceous.

*Male.* Measurements and ratios: N, 7; length, about 11 mm.; width, about 3.5 mm.; wing length,  $M = 3.53 \pm 0.211$  mm.; hooks in hamulus,  $M = 12.86 \pm 0.509$ ; flagellar segment 2/segment 1,  $M = 7.30 \pm 0.351$ .

Structure and color: Integument as in *bimatrix* except as follows: labrum without mediobasal pale spot; first flagellar segment yellow to red below; eyes greenish gray; wing membranes slightly milky, veins yellow to reddish yellow; tergal apices hyaline, colorless.

Structure as in *bimatrix* except as follows: minimum length of first flagellar segment equals about one-sixth maximum length of second segment, penultimate 3 or 4 segments not crenulate; maxillary palpal segments in ratio of about 4:3:3:1. Sculpturing as in female except as follows: tergum 1 with basal four-fifths punctate; terga 2 and 3 with interband zone punctures slightly larger and more crowded, and with apical area punctures indistinct and sparse; tergum 4 similar to tergum 3. Pygidial plate broad but more as in *bimatrix* than as in *relucens*, width at base subequal to median length and usually slightly less.

Sterna 7 and 8 and genital capsule as in *M. menuachus* except as follows: gonostyli gently curved in or straight, scarcely capitate, with hairs near base sparse; gonocoxite with a few extremely short hairs at apex just below gonostylus on ventral surface; spatha with well-marked, apicomedian, shallow notch; sternum 7 with median plate with apical margin transverse; sternum 8 with ventral tubercle bidentate, with abundant apical hairs.

Hair: Vestiture white to extremely pale ochraceous (usually pale ochraceous only on upper surface of thorax). Metasomal vestiture as in *bimatrix* except as follows: tergum 1 without distinct pale pubescent band obscuring apical margin except at extreme sides and these in width less than a third width of tergum; terga 2-4 with apical area hairs suberect and less abundant; tergum 2 with interband zone hairs suberect.

*Type Material.* The holotype female, allotype male and 23 female paratypes were collected by C. D. Michener at Dayton, Nevada, July 1, 1950 on *Penstemon palmeri*. Two female paratypes from Nevada are as follows: 1 female on June 20 and 1 female on June 29, 1927, at Nixon by E. P. Van Duzee. In addition, 17 fe-

male and 5 male paratypes from California are as follows: Hallelujah Junction, Lassen County: 1 male, July 7, 1949, P. D. Hurd; 1 male, July 13, 1949, P. D. Hurd; 1 male, July 13, 1949, E. I. Schlinger; 2 females and 2 males, July 13, 1949, F. Morishita; 11 females, July 13, 1949, on *Chrysothamnus* sp., P. D. Hurd; 3 females, August 9, 1949, on *Chrysothamnus* sp., J. W. MacSwain. Murphys, Calaveras County: 1 female, September 8-19, 1937, F. E. Blaisdell. The holotype and allotype are in the Snow Entomological Collection of the University of Kansas, Lawrence. Paratypes are in the collections of the Snow Entomological Collection, the University of California at Berkeley, the University of California at Davis, the California Academy of Sciences at San Francisco, P. H. Timblerlake at the Citrus Experiment Station, Riverside, California, the U. S. National Museum, Washington, D. C. and in the author's collection.

*Distribution.* Northern California, Nevada and Utah (Fig. 10). In addition to the 52 specimens from California and Nevada listed above as type material, 3 specimens have been examined from Utah as follows: Leota: 3 females, July 17, 1952, on sweet clover (*Melilotus* sp.), G. F. Knowlton and G. E. Bohart.

*Melissodes (Eumelissodes) perpolita*, n. sp.

This is a small coarsely punctate species similar to and related to *M. relucens*. The female of *perpolita* differs from that of *relucens* by the brown scutellar and mesoscutal hairs, the interband zone of tergum 2 being almost bare but with some brown hairs, the punctuation of tergum 2 as described below, the longer apical areas of terga 2 and 3 and the presence of a small median glabrous apical area on tergum 4. The male of *perpolita* can be told from that of *relucens* by the slightly narrower pygidial plate and the less hairy and less punctate (although more coarsely so) interband zone of tergum 2. The allotype is the only known male of *perpolita* and, since it was not collected with any of the females, the association of the two sexes is tentative.

*Female.* Measurements and ratios: N, 4; length, about 10 mm.; width, about 3.5 mm.; wing length,  $M = 3.12 \pm 0.225$  mm.; hooks in hamulus,  $M = 12.00 \pm 0.435$ ; flagellar segment 1/segment 2,  $M = 1.84 \pm 0.034$ .

*Structure and color:* Integumental color as in *relucens* except as follows: second flagellar segment dark below; eyes bluish gray (holotype) to gray; tegulae rufescent. Structure and sculpture as

in *menuachus* except as follows: clypeal punctures large, separated mostly by less than half a puncture width, surface unshagreened, apicomedian carina weak; supraclypeal area shiny; galeae shiny, unshagreened; lateral areas of vertex with punctures large, irregular, separated mostly by half to one puncture width; maxillary palpal ratio about 2.7:1.7:1.5:1.0; mesoscutal punctures very large, posteromedially larger than mesepisternal punctures and separated by half to two puncture widths (scattered irregularly), surface shiny; scutellar punctures slightly smaller, crowded; metasomal tergum 1 with basal two-thirds with round shallow punctures about same size as scutellar and separated mostly by half a puncture width, surface reticularly shagreened but shiny, apical area impunctate, finely shagreened, shiny, with anterolateral lobes separated from rest of apical area by an uneven double row of coarse punctures; tergum 2 with basal area punctures small, separated mostly by half to one puncture width, surface somewhat dulled by reticular shagreening, interband zone punctures irregular in size and distribution, largest as large as mesoscutal punctures, smallest minute, with conspicuous blank spaces between punctures, surface shiny with fine reticulotransverse shagreening, apical area impunctate, shiny, longer medially than distal pale band; tergum 3 similar to 2 but apical area shorter; tergum 4 similar to 3 but apical area reduced to small median triangle; pygidial plate V-shaped, apex acute.

Hair: Head white with brown on vertex. Thorax white with scutellum brown fringed with white and mesoscutum with posteromedian brown patch about one and one-half times size of scutellar dark area; tegulae without brown. Tergal vestiture as in *relucens* except as follows: tergum 2 with distal pale band slightly shorter than apical area medially, interband zone with short, simple subappressed to suberect hairs, usually at least partly brown and sparser than in *relucens*; tergum 3 similar but interband zone narrower and basal tomentum dark brown; tergum 4 with distal pale band interrupted apicomediaally by triangular apubescent area; hind basitarsi with inner surfaces yellow to dark red; scopae white.

*Male.* Measurements and ratios: N, 1; length, about 11 mm.; width, about 3 mm.; wing length, 3.18 mm.; hooks in hamulus, 12; flagellar segment 2/segment 1, 5.07.

Structure and color: Integumental color as in *relucens* except as follows: labrum and mandibles black; eyes yellowish gray; first flagellar segment slightly less than one-sixth maximum length second segment, penultimate segment one-third as wide as long or slightly



less; maxillary palpal ratio about 3.0:2.5:2.5:1.0; pygidial plate longer than broad, apicolateral notches deep so that apical part half median width. Sculpture as in female except as follows: clypeal punctures smaller; terga 2 and 3 with interband zones with large punctures more abundant and more crowded; terga 4 and 5 similar to 3 but apical areas shorter.

Hair: Head and thorax white. Metasomal vestiture as in *relucens* except as follows: tergum 1 with apical area exposed; terga 2 and 3 with interband zones with hair less abundant. Legs white except inner surfaces hind basitarsi yellow.

*Type Material.* The holotype female from Black Mesa (near Kayenta), Arizona, was collected by Isabel McCracken, September 11, 1936, on *Chaemataxis* sp. The allotype male from Bisbee (10 miles N. W.), Arizona, was collected by T. Cohn, P. Boone and M. Cazier, September 7, 1950. Two paratype females from Kaibab Forest, Utah, (this is probably mislabelled "Utah" and should be Arizona), were collected by I. McCracken, September 21, 1938, on *Aster* sp. One paratype female from Cortez, Colorado, was collected by I. McCracken, September 13, 1938, on *Grindelia* sp. The holotype and one paratype are in the collection of the California Academy of Sciences, San Francisco. The allotype is in the American Museum of Natural History, New York City. Paratypes are in the collection of the Snow Entomological Museum of the University of Kansas, Lawrence and in the author's collection (Fig. 15).

*Melissodes (Eumelissodes) fasciatella*, n. sp.

*M. fasciatella* is a small distinctive bee from Arizona known only in the female sex. It is not closely related to any of the foregoing species but bears some resemblance in the tergal banding and punctuation to *M. perpolita* so is treated here. *M. fasciatella* is distinctive in that the pale distal band of tergum 2 is reduced to two short lateral fasciae, each about one-third of the tergum in width and tapering sharply mesad, thus forming two short oblique fasciae. The extensive apical area of tergum 2 is impunctate and shiny. The galeae are shiny and hairs of the inner surfaces of the hind basitarsi are dark reddish brown.

*Female.* Measurements and ratios: N, 20; length, 9-10 mm.; width, 3.0-3.5 mm.; wing length,  $M = 2.71 \pm 0.067$  mm.; hooks in hamulus,  $M = 10.85 \pm 0.150$ ; flagellar segment 1/segment 2,  $M = 1.97 \pm 0.238$ .

Structure and color: Integument black except as follows: mandi-

bles and distitarsi rufescent; flagellar segments 3-10 red below; eyes bluish to greenish gray; wing membranes colorless to milky, veins dark reddish brown; tegulae piceous; tibial spurs yellow; tergal apices often slightly rufescent, tergum 1 narrowly hyaline apically.

Structure and sculpture as in *perpolita* except as follows: lateral areas vertex with minute punctures separated by two to four puncture widths, surface shiny; maxillary palpal ratio about 2.0:1.7:1.7:1.0; mesoscutal punctures large but not larger than mesepisternal, small posteromedial area usually impunctate, elsewhere punctures separated mostly by half to one puncture width, surface shiny, often (not in holotype) with fine reticular shagreening; mesepisternal punctures large, deep, separated by less than half a puncture width, surface shiny; metasomal tergum 1 with basal half or slightly more with large round punctures, not very shallow, separated mostly by half a puncture width or slightly more, surface reticulotransversely shagreened but shiny, apical area impunctate, shiny; tergum 2 with basal area punctures large, slightly less in diameter than those of base of tergum 1, separated mostly by half a puncture width, interband zone punctures smaller to slightly larger than those of basal area, separated by half a puncture width laterally to one or two puncture widths in median third, apical area impunctate, highly shiny; tergum 3 similar to 2 but apical area shorter and interband zone punctures small and denser; tergum 4 like 3 but lacking apical area; pygidial plate V-shaped, apex rounded, longer than broad.

Hair: Head white to pale ochraceous on vertex, vertex with few or no brown hairs. Thorax white laterally; scutellum dark brown fringed with pale ochraceous; mesoscutum pale ochraceous with large posteromedian dark brown patch usually twice size of scutellar dark area or larger; tegulae without brown; mesoscutal hairs short, blunt-tipped and usually decumbent except peripherally. Metasomal tergum 1 white to pale ochraceous basally and to apical margin at extreme sides, glabrous apicomediaally; tergum 2 white basally; distal pale band in form of two lateral fasciae, each one-third or less width of tergum and sharply tapered towards middle of tergum to form short, oblique, lateral fasciae, interband zone with sparse, appressed to subappressed, pale ochraceous pubescence and bristle-like hairs, apical area glabrous; tergum 3 similar to 2 but basal tomentum brown, distal pale band not interrupted medially (although posterior margin slants forward to an obtuse point medially), and apical area shorter; tergum 4 like 3 but distal pale band reaches apical margin across entire tergum; terga 5 and 6 dark brown with

lateral white tufts at least on 5; sterna brown medially to white laterally. Legs white except as follows: fore tarsi, outer-apical surfaces fore and middle tibiae, and basitibial plates brown; inner surfaces hind basitarsi dark reddish brown to dark brown.

*Type Material.* The holotype female and one female paratype from Todd's Lodge, Oak Creek Canyon, Arizona, was collected on September 7, 1948, by Grace H. and John L. Sperry. The Sperrys also collected one female paratype at Todd's Lodge on September 29, 1948. In addition, 32 female paratypes from Arizona are as follows: Dos Cabezas (16 miles S.): 1 female, September 8, 1950, T. Cohn, P. Boone and M. Cazier. East Verde River: 6 females collected at 4,500 feet altitude. Madera Canyon, Santa Rita Mts.: 1 female on *Aplopappus gracile*, September 23, 1956, F. G. Werner. Onion Saddle (9 miles W.), Chiricahua Mts.: 2 females, September 10, 1954, J. C. Hall; 5 females on *A. gracilis*, September 10, 1954,

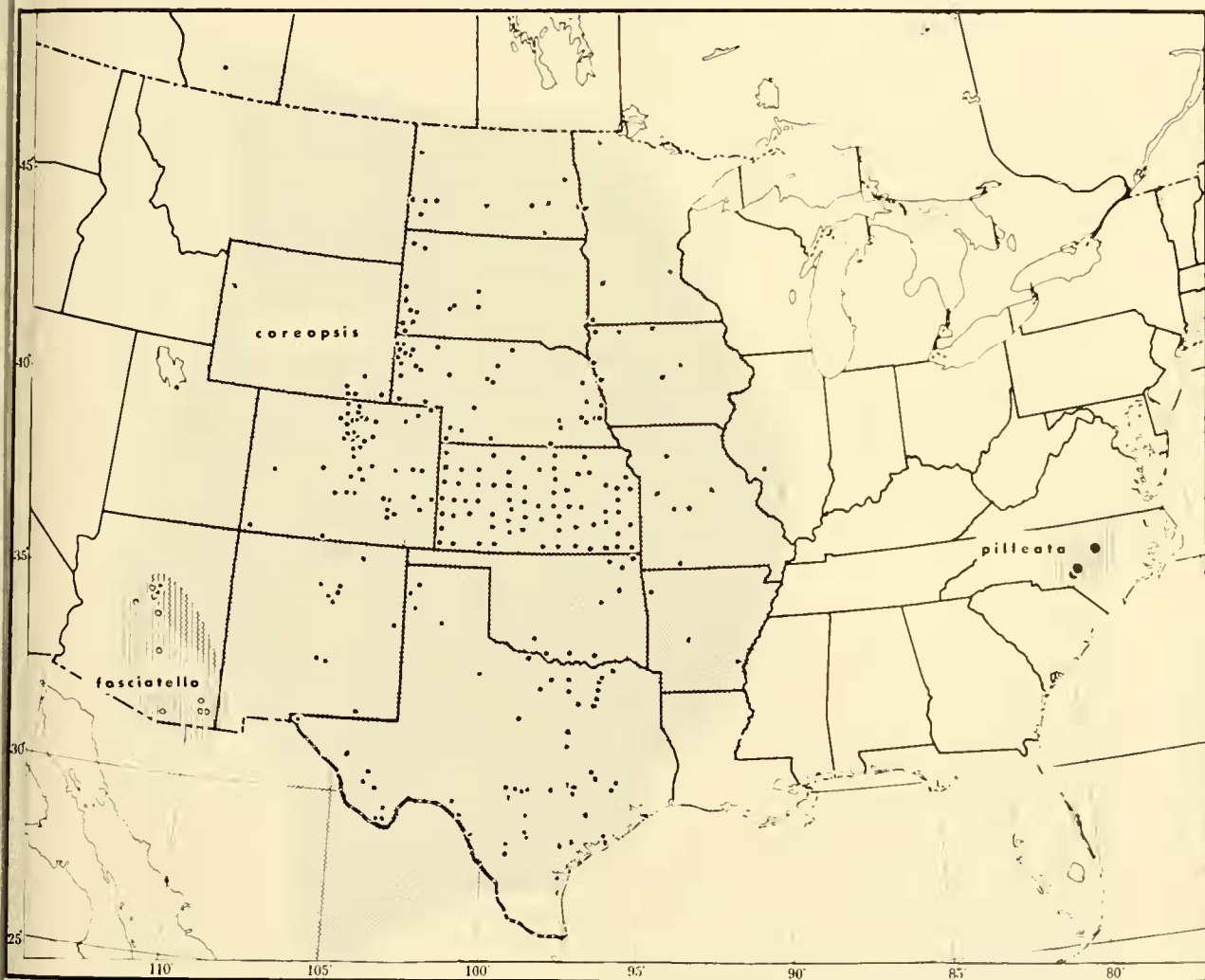


FIG. 16. Map showing the known distributions of *M. (Eumelissodes) fasciatella* LaBerge, *M. (E.) coreopsis* Robertson, and *M. (E.) pilleata* LaBerge.



P. H. Timberlake. Prescott: 2 females on *A. gracilis*, September 17, 1953, P. H. Timberlake. Price (2.9 miles N.): 3 females on *Erigeron* sp., 3 females on *A. gracilis*, September 17, 1953, P. H. Timberlake. Sedona: 2 females, September 14, 1955, G. D. Butler; 1 female on *Viguiera* sp. (10 miles N.), September 13, 1955, G. D. Butler. Seligman: 1 female on *Gutierrezia* sp., August 29, 1931, P. H. Timberlake. Southwest Research Station (5 miles W. of Portal): 2 females, September 8, 1955, W. Gertsch and E. Ordway. S. Arizona: 3 females, August 1902, F. H. Snow. The holotype is in the collection of the Snow Entomological Museum of the University of Kansas, Lawrence. Paratypes are in the collections of the Snow Entomological Museum, P. H. Timberlake, Riverside, California, The American Museum of Natural History, New York City, the U. S. National Museum, Washington, D. C., the University of Arizona, Tucson, the University of California at Davis, and in the author's collection (Fig. 16).

*Melissodes (Eumelissodes) coreopsis* Robertson

- Melissodes coreopsis* Robertson, 1905, Trans. Amer. Ent. Soc., vol. 31, p. 368; 1914, Ent. News, vol. 25, p. 69; 1926, Ecology, vol. 7, p. 379; 1928, Flowers and Insects, p. 8.
- Melissodes agilis semiagilis* Cockerell, 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 364 (new synonymy); 1907, Univ. Colo. Studies, 4:225; 1914, Canadian Ent., 46:413; 1919, Canadian Ent., 51:27; 1928, Univ. Colo. Studies, 16:114.
- Melissodes confusiformis* Cockerell, 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 366 (new synonymy); 1907, Univ. Colorado Studies, vol. 4, p. 255; 1910, Psyche, vol. 17, p. 246; 1914, Canadian Ent., vol. 46, p. 409; 1919, Canadian Ent., vol. 51, p. 272; 1923, Ent. News, vol. 34, p. 47; Bohart, Knowlton and Bailey, 1950, Utah St. Agric. Coll., Mimeo. Ser. No. 371, p. 5.
- Melissodes helianthophila* Cockerell, 1914, Ann. Mag. Nat. Hist., ser. 8, vol. 14, p. 361 (new synonymy).
- Melissodes confusa*, Robertson (*nec* Cresson, 1878), 1894, Trans. Acad. Sci. St. Louis, vol. 6, pp. 458-460, 468, 471, 474, 475; 1896, Trans. Acad. Sci. St. Louis, vol. 7, pp. 175, 176, 178; 1897, Trans. Acad. Sci. St. Louis, vol. 7, p. 355.

*Melissodes coreopsis* is the most common species of *Eumelissodes* of the Great Plains except perhaps *M. agilis*. It is a medium-sized bee, the female of which has black and white metasomal bands, a large black dorsal thoracic patch, pale scopal hairs with dark hairs on the inner surfaces of the hind basitarsi, and short subappressed dark hairs in the apical areas of terga 2 and 3. It is not closely related to any of the foregoing species but is most similar to *M. rustica* from which it differs by the paler thoracic and head hairs of both sexes, the less shiny terga of both sexes, the paler scopal hairs of the female, and the hyaline tergal apices and shorter first flagellar segment of the male. A relatively complete description

is given below after which subsequently described and related species are patterned.

*Female.* Measurements and ratios: N, 20; length, 9-14 mm.; width, 3.0-4.5 mm.; wing length,  $M = 3.38 \pm 0.196$  mm.; hooks in hamulus,  $M = 12.70 \pm 0.206$ ; flagellar segment 1/segment 2,  $M = 1.76 \pm 0.024$ .

Structure and color: Integument black except as follows: apical half of mandibles and distitarsi (often basitarsi and tibiae as well) rufescent; lower surfaces of flagellar segments 3-10 and often apex of second segment yellow to red; eyes blue to bluish gray or dark gray; wing membranes hyaline, colorless or slightly milky, veins dark brown to black; tegulae piceous, occasionally slightly testaceous; tibial spurs white to yellow; tergum 1 usually rufescent in apical third or half and with extremely narrow apical margin hyaline and colorless or yellow.

Clypeus flat, oculoclypeal distance half minimum width of first flagellar segment or less, with punctures relatively regular, deep, round, separated mostly by half a puncture width or less, surface shiny, with irregular cross-striations especially near base; supraclypeal area with punctures sparse or absent medially, usually slightly dulled by fine reticular shagreening; vertex with flattened lateral areas with small round punctures separated by one to two or more puncture widths, surface usually shiny; galeae above shiny, unshagreened except near tips; maxillary palpal ratio about 9:6:5:1, last segment often almost obliterated. Mesoscutal punctures large, round, deep, posteromedially larger and separated by one to three puncture widths, anteriorly and laterally smaller and separated by half to one puncture width or less; scutellar punctures smaller, medially separated mostly by one to two puncture widths; mesepisterna with lateral surface punctures as large or larger than posteromedian mesoscutal punctures, separated mostly by less than half a puncture width; surfaces of mesoscutum and scutellum usually shiny, often slightly dulled by delicate reticular shagreening; surfaces of mesepisterna usually unshagreened; propodeum with dorsal surface reticulorugose, coarser near base, posterior surface with abundant shallow punctures except in upper inverted triangular area, lateral surfaces densely punctate, surfaces everywhere dulled by fine, dense tessellation. Metasomal tergum 1 with basal half to three-fifths with small shallow punctures separated mostly by half a puncture width, apical impunctate area extended basally on each side to form indistinct anterolateral lobes, surface dulled

by dense reticulotransverse shagreening; tergum 2 with basal area punctures round, deep, separated by half to one puncture width, larger apically, surface shiny and unshagreened, interband zone punctures larger and shallower, separated by half to one puncture width laterally and mostly by one puncture width medially, surface dulled by dense reticulotransverse shagreening, apical area impunctate or with minute, widely separated punctures, surface dulled by dense shagreening; tergum 3 similar to 2 but punctures of interband zone smaller and more crowded and apical area with minute punctures somewhat more abundant. Pygidial plate broadly V-shaped with rounded apex, longer than breadth at base.

Hair: Head white to pale ochraceous with long brown hairs on vertex. Thorax white to pale ochraceous except scutellum dark brown with pale fringe and mesoscutum with posteromedian dark patch as large and usually larger than scutellar dark area; tegulae usually with brown hairs posteromedially. Metasomal tergum 1 with basal area white to pale ochraceous, apical area glabrous; tergum 2 with basal tomentum white and connected laterally by white pubescence to distal pale band, distal band white, laterally longer than apical area, narrowly interrupted medially, interband zone hairs subappressed to suberect, all or mostly dark brown, apical area with short, subappressed, relatively simple, brown to black hairs usually present except near apex; tergum 3 as in 2 but basal tomentum brown, distal pale band broader and usually uninterrupted medially, apical area narrower (distal pale band may reach apex at extreme sides), and with more abundant simple, subappressed, dark hairs in apical area; tergum 4 with apical pubescent band broad, white, uninterrupted posteromedially; terga 5 and 6 dark brown with pale lateral tufts; sterna brown or reddish brown medially to white laterally. Legs pale ochraceous to white except as follows: distitarsi yellow to reddish brown; fore basitarsi, inner surface middle and hind basitarsi, on and surrounding pygidial plate and often outer surfaces of apices of fore and middle tibiae reddish brown to dark brown; inner surfaces hind tibiae yellow.

*Male.* Measurements and ratios: N, 20; length, 8-12 mm.; width, 2.5-4.0 mm.; wing length,  $M = 3.40 \pm 0.126$  mm.; hooks in hamulus,  $M = 12.10 \pm 0.143$ ; flagellar segment 2/segment 1,  $M = 8.71 \pm 0.204$ .

Structure and color: Integument black except as follows: clypeus yellow except apical margin testaceous to brown; mandibular bases without yellow maculae; labrum entirely black or with small medio-



basal pale spot (in about 50 per cent of specimens); eyes yellow-brown, green or bluish green; flagellum yellow below, dark red to brown above; wing membranes colorless to slightly milky, veins dark red to brown; tegulae usually testaceous; apical tergal areas hyaline, colorless or slightly yellow, basal to hyaline area usually rufescent on at least terga 2 and 3; distitarsi and often basitarsi rufescent; tibial spurs white to pale yellow.

Clypeus as in female; first flagellar segment with minimum length equal to less than two-thirds maximum length and equal to one-tenth or less maximum length of second segment, penultimate segment more than three times as long as broad, flagellum in repose surpassing pterostigma, segments 4-10 without longitudinal lateral depressions; maxillary palpal ratio about 8:5:4:1, last segment occasionally absent. Sculpturing as in female except as follows: mesoscutum with posteromedian area punctures often somewhat more crowded; tergum 1 medially with basal four-fifths punctate, punctures separated mostly by one puncture width; terga 2 and 3 interband zone punctures more abundant; terga 2-4 with apical areas impunctate or virtually so, dulled, with shagreening often more reticular and less transverse, especially in interband zones; sterna moderately shiny, surfaces usually with coarse reticular shagreening. Terminalia as in *M. agilis*.

Hair: White to pale ochraceous; vertex of head and dorsum of thorax usually more ochraceous than elsewhere; metasomal hairs and pubescence entirely pale, as in *M. menuachus* except as follows: tergum 1 with apical area with long, subappressed, relatively simple, pale hairs usually present but not forming dense band hiding margin; tergum 2 with distal pale band narrow, usually half to three-fourths as wide as apical area medially, as long as or longer than apical area laterally, occasionally narrowly interrupted medially; terga 2-4 with apical areas progressively shorter, with abundant long subappressed to suberect, relatively simple, pale hairs. Legs white to pale ochraceous except yellow to reddish yellow on inner surfaces of tarsi and hind tibiae.

*Remarks.* Dr. Delma Harding of the Zoology and Entomology Department, Iowa State College, Ames, Iowa, has provided the author with an excellent photograph (Fig. 1) of a female bee visiting *Helianthus petiolaris* in Kansas. This bee is most likely the female of *M. coreopsis*.

*Bionomics.* Out of 1,986 specimens of *M. coreopsis* available for study, 1,061 bear flower labels. These data are summarized in

Table VII and indicate that *coreopsis* is oligolectic on plants of the family Compositae. The bee visits a great variety of composite genera and species for pollen as well as nectar, and shows some preference for the genus *Helianthus* and related genera.

TABLE VII. Summary of Floral Records for *Melissodes coreopsis*.

Plant Data			Records of <i>M. coreopsis</i>			
FAMILY	Number of genera	Number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae:						
<i>Helianthus</i> spp.	1	6	86	211	124	335
<i>Gaillardia</i> spp.	1	1	17	54	14	68
<i>Rudbeckia</i> spp.	1	3	16	44	65	109
<i>Echinacea</i> spp.	1	3	18	36	13	49
<i>Grindelia</i> spp.	1	1	15	22	4	26
<i>Solidago</i> spp.	1	3	15	15	78	93
<i>Aster</i> spp.	1	2	14	38	3	41
<i>Coreopsis</i> spp.	1	2	8	25	3	28
Other genera	19	23	56	77	82	159
Leguminosae	8	12	41	32	43	75
Labiatae	3	5	13	12	30	42
Other families (12)	13	15	31	13	23	36
Totals	51	76	330	579	482	1,061

*Type Material.* The lectotype female, here designated, of *coreopsis*, collected by Charles A. Robertson at Carlinville, Illinois, June 14, 1902 on *Coreopsis palmata*, is in the collection of the Illinois Natural History Survey at Urbana. The holotype female of *confusiformis* from Fedor, Lee County, Texas, May 6, 1902, is in the collection of the Natural History Museum of the University of Colorado at Boulder. The holotype male of *helianthophila*, collected by T. D. A. Cockerell at Boulder, Colorado, June 16, on *Helianthus*

*lenticularis*, is in the collection of P. H. Timberlake at the Citrus Experiment Station, Riverside, California.

*Distribution.* *M. coreopsis* is distributed from Alberta, North Dakota and Minnesota south to Oaxaca in Mexico, east to Indiana and west to Utah and Arizona (Fig. 16). It has been collected from April 11 to November 6. It seems likely that in Texas where *coreopsis* is abundant from April until November there are three generations of bees per year. In Kansas where this bee is active from June until mid-October, there are probably two generations and in North Dakota where the season of activity is limited to July, August and September, there is likely to be only one generation. In addition to the type material, a total of 1,121 females and 865 males have been examined from the localities listed below. Of these 1,986 specimens, 1,140 are from the state of Kansas. Therefore, locality records from that state are given below only as counties in order to conserve space. Localities reported in the literature are included in the list.

ARIZONA: Douglas; Flagstaff (Walnut Canyon); Oak Creek Canyon. ARKANSAS: Desha Co.; Hot Springs; Washington Co. COLORADO: Antonito; Beneva Park; Berkeley; Boulder; Boulder Canyon; Brighton; Buckeye (S. at Horsecreek); Cameron Pass; Canon City; Chimney Gulch; Clear Creek; Colorado Springs; Cory; Cotopaxi; Crook, Logan Co.; Crowley Co.; Denver; Dixon Canyon; Eads; Elbert; Eldora; Estes Park; Fort Collins; Glen Haven; Jim Creek (near Boulder); La Junta; Lamar; Larimer Co.; Limon; Masonville; Mesa Verde; Ovid (3 miles E.); Palmer Lake; Pingree Park, Larimer Co.; Platte Canyon; Portland; Prospect, Weld Co.; Puils Creek, Crowley Co.; Rock Creek, Teller Co.; Rocky Ford; Seibert (13 miles E.); Sterling; Stratton; Ten-sheep Ranch; Timpas; Towner, Kiowa Co.; Trimnath; Valmont (Owens Lake); Virginia Dale; White Rocks (near Boulder). ILLINOIS: Carlinville; Macoupin Co. IOWA: Ames; Buffalo Center (5 miles N. W.); Dickinson Co.; Grundy Co.; Lyon Co.; Onawa; Sioux City. KANSAS: Counties: Anderson; Barton; Bourbon; Butler; Chase; Chautauqua; Cherokee; Cheyenne; Clark; Cloud; Coffey; Cowley; Dickinson; Douglas; Edwards; Ellis; Finney; Ford; Franklin; Gove; Greeley; Greenwood; Hamilton; Harper; Harvey; Hodgeman; Johnson; Kearny; Kiowa; Labette; Lane; Leavenworth; Logan; McPherson; Marion; Marshall; Meade; Mitchell; Montgomery; Morton; Neosho; Norton; Ottawa; Pawnee; Pottawatomie; Pratt; Reno; Republic; Rice; Riley; Rooks; Rush; Russell; Saline; Scott; Sedgwick; Shaw-



nee; Sheridan; Sherman; Smith; Stafford; Stanton; Stevens; Sumner; Thomas; Trego; Wallace; Wichita; Woodson. MINNESOTA: Moorhead; Rock Co.; Roseau Co.; St. Paul; Yellow Medicine Co. MISSOURI: Branson; Chillicothe (6 miles N.); Columbia; Holden; Ozark Lakes; Warsaw. NEBRASKA: Agate, Sioux Co.; Alliance; Box Butte Co.; Brown Co.; Cambridge; Carns; Cedar Bluffs; Crawford; Dunning; Fairmont; Glen, Sioux Co.; Gordon; Haigler; Halsey; Hamlet, Hays Co.; Hardy; Harrison; Hyannis (9 miles S.); Imperial; Kimball; Lincoln; Lodgepole; McCool Jr.; Malcolm; Mitchell; Monroe Canyon, Sioux Co.; North Platte (8 miles W.); Omaha; Pine Ridge, Dawes Co.; Sioux Co.; Wabash; War Bonnet Canyon, Sioux Co.; Weeping Water; West Point. NEW MEXICO: Capitan; Carlsbad Caverns; Corrizozo; Grady; Las Vegas; Maxwell; Rowe; San Jose; Santa Fe (35 miles E.); Sapello. NORTH DAKOTA: Amidon; Beach; Belfield; Bismarck; Dickinson; Fargo; Hatton; Jamestown; Oakes; Ravinia; Williston; Valley City. OKLAHOMA: Ardmore; Caddo; Lawton; Nowata (5 miles N.); Okmulgee; Quapaw; Wagoner (5 miles N.); Waurika; Vinita. SOUTH DAKOTA: Ardmore; Buffalo; Cedar Pass (Badlands); Custer; Custer Co.; Deadwood (10 miles S.); Deerfield; Edgemont; Hot Springs; Interior; Okaton; Slim Buttes; Stanley Co. TEXAS: Adrian; Alford; Alpine (20 miles S.); Atascosa Co.; Austin; Bay City; Bexar Co.; Big Bend National Park; Brazos Co.; Brewster Co.; Chisos Mts. (Big Bend. N. Park); College Station; Corpus Christi; Cotulla; Dalhart (Rita Blanca Lake); Dallas; Del Rio; Denton; Devil's River; Dilley; Eastland Co.; El Paso (15 miles N.); Fedor, Lee Co.; Fort Davis; Fredricksburg; Giddings; Goliad (16 miles E.); Greenville; Guthrie; Harper; Hetty; Hillsboro; Jack Co.; Johnson City (6 miles W.); Kerrville; Ladonia; Lee Co.; Lobo, Culberson Co.; Magnolia; Marfa; Matagorda; Palo Duro Canyon, Randall Co.; Paris; Plano; Poteet; Quemado, Maverick Co.; Roanoke; Rock Island; Romero; Stonewall; Terrell; Victoria; Waco; Wichita Falls; Willis; Wolfe City. UTAH: Lakepoint. WYOMING: Albany Co.; Diamond Ranch, Platte Co.; Grand Teton National Park; Laramie (37 miles E.); Laramie Co.; Summit; Tie Siding. Canada. ALBERTA: Lethbridge. Mexico. OAXACA: Nochixtlan (7 miles S. E.).

*Flower Records.* *Amphiachyris* sp., *A. dracunculoides*, *Amorpha canescens*, *A. fruticosa*, *Aster* sp., *A. ericoides villosis*, *A. multiflora*, *A. novaeangliae*, *A. paniculatus*, *A. praeatus*, *Bidens* sp., *B. involucrata*, *Boltonia asteroides*, *Chrysopsis* sp., *C. angustifolia*, *Chrysanthamnus graveolus*, *Cirsium* sp., *Clematis* sp., *Cleome serrulata*,

*Cooperia pedunculata*, *Convolvulus* sp., *Coreopsis* sp., *C. grandiflorum*, *C. palmata*, *C. tinctoria*, *Cosmos* sp., *Echinacea* sp., *E. angustifolia*, *E. pallida*, *E. purpurea*, *Erucastrum pollichii*, *Eryngium* sp., *E. leavenworthii*, *Eupatorium altissimum*, *Euphorbia* sp., *Eustoma russellianum*, *Gaillardia* sp., *G. pulchella*, *Geranium* sp., *Gossypium herbaceum*, *Grindelia* sp., *G. squarrosa*, *Gutierrezia sarothrae*, *Haplopappus* sp., *Helenium* sp., *H. autumnale*, *H. laciniatum*, *H. latifolia*, *H. nudiflorum*, *H. tenuifolium*, *Heterotheca subaxillaris*, *Helianthus* sp., *H. annuus*, *H. grosse-serratus*, *H. maximillianus*, *H. petiolaris*, *H. salicifolius*, *H. tuberosus*, *Heliopsis helianthoides*, *Marrubium vulgare*, *Medicago sativa*, *Melilotus alba*, *M. officinalis*, *Monarda* sp., *M. citriodora*, *M. pectinata*, *M. punctata*, *Nepeta cataria*, *Opuntia* sp., *O. lindheimeri*, *O. macrorhiza*, *Parosela* sp., *Petalostemum* sp., *P. candidum*, *P. oligophyllum*, *P. purpureum*, *Prionopsis* sp., *P. ciliata*, *Psoralea floribunda*, *Ratibida* sp., *R. columnaris*, *R. pinnata*, *Rudbeckia* sp., *R. amplexicaulis*, *R. bicolor*, *R. hirta*, *R. laciniata*, *R. triloba*, *Salsola pestifer*, *Silphium* sp., *S. perfoliatum*, *S. speciosum*, *Solidago* sp., *S. canadensis*, *S. rigida*, *S. serotina*, *Tetragonotheca ludoviciana*, *Tetraneuris linearifolia*, *Trifolium repens*, *Verbena* sp., *V. officinalis*, *V. stricta*, *Verbesina encelioides*, *Vernonia* sp.

### *Melissodes (Eumelissodes) nivea* Robertson

*Melissodes nivea* Robertson, 1895, Trans. Amer. Ent. Soc., vol. 22, p. 127; 1897, Trans. Acad. Sci. St. Louis, vol. 7, p. 354; 1905, Trans. Amer. Ent. Soc., vol. 31, p. 368; Cockerell, 1907, Ann. Mag. Nat. Hist., ser. 7, vol. 20, p. 128; Robertson, 1928, Flowers and Insects, p. 8; Pearson, 1933, Ecol. Monogr., vol. 3, p. 381; Graenicher, 1935, Ann. Ent. Soc. Amer., vol. 28, p. 304; Brimley, 1938, Insects of North Carolina, p. 462.

*Melissodes nivea* is closely related to *M. coreopsis*. The females of *nivea* can be distinguished from those of *coreopsis* primarily by the small but distinct punctures in the apical areas of terga 2 and 3 and by the short, white hairs in the same areas. The male is very similar to the male of *M. agilis* in the color of the labrum, mandibles and wing veins, but is like *M. coreopsis* in the extremely short first flagellar segments and in the shiny galeae. The pale pubescence and hairs of both sexes of *nivea* tend to be white, rather than dull ochraceous as in *coreopsis* or rufescent as in *agilis*.

*Female.* Measurements and ratios: N, 20; length, 9-12 mm.; width, 4.0-4.5 mm.; wing length,  $M = 2.84 \pm 0.095$  mm.; hooks in hamulus,  $M = 11.30 \pm 0.128$ ; flagellar segment 1/segment 2,  $M = 1.70 \pm 0.019$ .

Structure and color: Integumental color as in *coreopsis* except

as follows: wing veins dark red to reddish brown; tergum 1 with apical third occasionally rufescent, apical margin narrowly hyaline.

Structure and sculpturing as in *coreopsis* except as follows: clypeal punctures round, separated by less than half a puncture width, surface shiny with sparse striations, apicomedian longitudinal carina usually present; supraclypeal area usually dulled by reticular shagreening, with scattered coarse punctures; maxillary palpal ratio about 2.5:2.5:2.0:1.0, last segment sometimes slightly shorter. Mesoscutal punctures round, posteromedially deep, larger, separated mostly by one to two puncture widths, anteriorly and laterally slightly smaller, shallow, separated mostly by half a puncture width or less; scutellar punctures similar to posteromedial mesoscutal punctures but more crowded; surfaces of mesoscutum and scutellum shiny, often slightly dulled by fine reticular shagreening; mesepisternal punctures as large as posteromedian mesoscutal punctures; separated by half a puncture width or less, surface shiny, unshagreened or extremely delicately and irregularly so. Metasomal tergum 1 with basal area punctures larger and more crowded, apical impunctate area moderately shiny to shiny, with delicate reticulotransverse shagreening; tergum 2 with interband zone punctures small, deep, relatively regularly spaced, separated by half to one puncture width, apical area with small distinct punctures two to three times as wide as bases of appressed hairs arising from them, surface (especially of apical area) shiny to moderately shiny; tergum 3 similar to 2 but with interband zone and apical area punctures more crowded. Pygidial plate V-shaped with sides diverging posteriorly and apex well rounded, longer than basal breadth.

Hair: Head white with abundant long brown hairs on vertex. Thorax white except mesoscutum with dark brown posteromedian patch often extending forward to a transverse line at anterior margins of tegulae and almost reaching tegulae laterally (darkest in eastern specimens), scutellar hairs dark brown except white fringe, tegulae dark brown, and pale hairs of mesoscutum often pale cinereous. Metasoma as in *coreopsis* except as follows: tergum 2 with distal pale band white, as long as or longer than apical area medially, interband zone hairs mostly dark brown in specimens from Atlantic states and mostly white in specimens from prairie states, apical area with short, relatively simple, appressed to subappressed, white hairs (occasionally a few brown medially in darkest forms); tergum 3 similar to 2 but apical area shorter and often with median hairs brown; tergum 4 with apical white band never interrupted



medially nor fringed apically with brown; terga 5 and 6 with conspicuous lateral white tufts. Legs as in *coreopsis* but inner surfaces hind basitarsi more often reddish brown than darker.

*Male.* Measurements and ratios: N, 20; length, 9-12 mm.; width, 3-4 mm.; wing length,  $M = 2.85 \pm 0.135$  mm.; hooks in hamulus,  $M = 10.60 \pm 0.323$ ; flagellar segment 2/segment 1,  $M = 10.54 \pm 0.183$ .

Structure and color: Integumental color as in *M. agilis* except as follows: labral pale spot occasionally reduced but never absent, basal mandibular yellow maculae often reduced in size and rarely absent; tergal apices hyaline and colorless.

Structure as in *coreopsis* except as follows: first flagellar segment with minimum length equal to one-tenth or less of maximum length of second segment, penultimate segment slightly longer than three times minimum width, segments 5-10 slightly crenulate when viewed from below, flagellum in repose just reaching pterostigma; maxillary palpal segments in ratio of about 3.5:4.5:3.0:1.0, last segment often slightly longer. Sculpturing as in female except as follows: mesoscutal punctures smaller, often more crowded posteromedially; tergum 1 medially with basal four-fifths punctate; terga 2 and 3 with apical areas not distinctly punctate, shiny. Terminalia as in *agilis*, but sternum 8 with apicoventral tubercle pointed, not bidentate, and slightly surpassing apical margin in apicomedian emargination.

Hair: White except inner surfaces tarsi yellow and occasionally dorsum of thorax slightly cinereous. Metasomal tergum 2 with distal pale band as wide as apical area medially or wider; terga 2 and 3 with apical areas with abundant, suberect to subappressed, relatively simple, white hairs; tergum 1 with pubescent not forming thick apical band hiding margin of tergum.

*Bionomics.* Of 58 specimens representing 29 collections which have floral data attached, 54 specimens (28 collections) were taken on some species of Compositae. The single collection not from a composite consists of four females taken on *Gerardia* sp. (Scrophulariaceae). *M. nivea* can, accordingly, be considered as an oligolege of composites and has some preference for species of the genera *Solidago*, *Aster*, and *Liatris* in that order.

*Type Material.* Lectotype female, here designated, of *nivea*, collected by Charles A. Robertson (Coll. No. 3205) at Carlinville, Illinois, September 8, 1886, on *Solidago lanceolata* is in the collection of the Illinois Natural History Survey at Urbana. The lecto-

allotype male of *nivea*, here designated, collected by Robertson (Coll. No. 17648) at Carlinville, Illinois, August 21, 1895, on *Lepachys pinnata* is also in the Illinois Natural History Survey collection.

*Distribution.* *M. nivea* occurs from Long Island, New York, south to North Carolina and Alabama, and west to Minnesota, Kansas, Arkansas and Mississippi (Fig. 17). It has been collected from July 16 to October 14, but chiefly in September. In addition to the type material, a total of 136 females and 91 males have been examined from the localities listed below. This list includes localities reported in the literature.

ALABAMA: Mobile. ARKANSAS: Fort Smith (25 miles N.), Ouachita Mts.; Knob Hill Reservation, Ouachita Mts. DISTRICT OF COLUMBIA: Washington. ILLINOIS: Carbondale; Carlinville; Macoupin

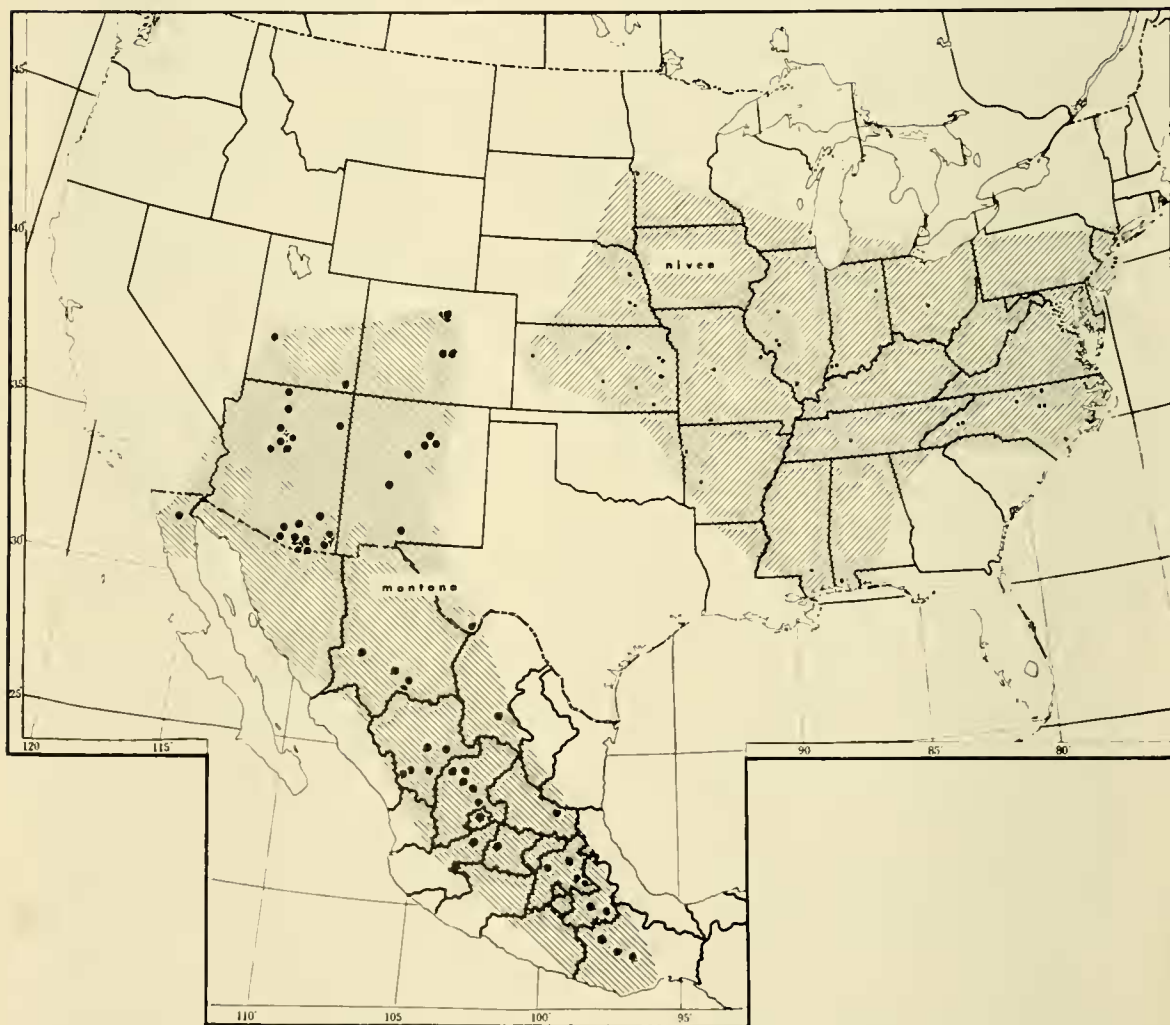


FIG. 17. Map showing the known distributions of *M. (Eumelissodes) nivea* Robertson and *M. (E.) montana* Cresson.

Co.; Manito. INDIANA: Bluffton; Gibson Co.; Rush Branch. KANSAS: Baldwin; Cherryvale (2 miles S.); Douglas Co.; Garnett; Hutchinson; Logan Co.; Reece; Riley Co. MARYLAND: Bethesda; Cabin John; Glen Echo; Indian Head. MINNESOTA: Ortonville. MISSISSIPPI: Camp Shelby (near Hattiesburg). MISSOURI: Branson; Gilmore; Ozark Lake. NEBRASKA: Lincoln; Malcolm; West Point. NEW JERSEY: Asbury Park; Jamesburg; Lakehurst; Lakewood. NEW YORK: Astoria, Long Island. NORTH CAROLINA: Black Mts. (valley of); Burgaw; Crabtree Meadows Park; Greensboro; Oxford; Raleigh; Swannanoa. OHIO: Columbus. PENNSYLVANIA: Darby. TENNESSEE: Maury Co. VIRGINIA: Arlington; Barcroft; Camp Peary; Falls Church; Fort Humphreys; Four-mile Run (near mouth of); Glen Carlyn; Mathias Point; Vienna; Virginia Beach. WISCONSIN: Milwaukee.

*Flower Records.* *Aster* sp., *A. ericoides*, *A. sagittifolius*, *Bidens laevis*, *Boltonia asteroides*, *Chrysopsis mariana*, *Gerardia* sp., *Helanium* sp., *Helianthus* sp., *H. annuus*, *H. atrorubens*, *Lacinaria* sp., *Lepachys pinnata*, *Liatris graminifolia*, *Prionopsis ciliata*, *Solidago* sp., *S. canadensis*, *S. lanceolata*, *S. rigida*, *S. serotina*, *Vernonia* sp., *V. glauca*.

*Melissodes (Eumelissodes) pilleata*, n. sp.

This is a medium-sized, black and white bee related both to *M. coreopsis* and to *M. rustica*. The female resembles that of *coreopsis* in sculpturing and in vestiture coloration but can be distinguished by the black fringe of hairs at the apex of tergum 4, the lack of pale lateral tufts on terga 5 and 6, and the broad pygidial plate. The female is readily confused with that of several closely related species whose descriptions follow below. The male is like *rustica* in having the apical tergal areas piceous, but is like *agilis* in having pale spots at the bases of the mandibles and on the labrum, and is like *coreopsis* in the short first flagellar segment and the shiny galeae. Both sexes have the wing membranes slightly infumate.

*Female.* Measurements and ratios: N, 20; length, 10-14 mm.; width, 3.5-4.5 mm.; wing length,  $M = 3.27 \pm 0.089$  mm.; hooks in hamulus,  $M = 12.60 \pm 0.143$ ; flagellar segment 1/segment 2,  $M = 1.90 \pm 0.002$ .

Structure and color: Integument black except as follows: apical half of mandible, lower surfaces flagellar segments 3-10, and distitarsi rufescent; eyes grayish blue to dark gray; wing membranes somewhat infumate with slight violaceous reflections, veins dark



brown to black; tegulae piceous; tibial spurs yellow to red; tergum 1 with extremely narrow apical margin hyaline or testaceous.

Structure and sculpturing as in *coreopsis* except as follows: clypeus slightly protuberant, oculoclypeal distance equals 0.50 to 0.75 times minimum diameter first flagellar segment, with regular round punctures separated mostly by half a puncture width, smaller and crowded anteriorly, without distinct longitudinal carina, surface moderately shiny, with sparse but distinct striations, supraclypeal area usually with several large deep punctures, surface shiny or slightly dulled by sparse reticular shagreening; galeae unshagreened above except at tips; maxillary palpal ratio about 2.25:2.50:2.25:1.00, a small fifth segment often present; metasomal tergum 1 with basal three-fifths with relatively large shallow punctures separated mostly by half to one puncture width; tergum 2 with basal area punctures separated mostly by half a puncture width; terga 2 and 3 with apical areas with minute scattered punctures no broader than twice diameter of hairs arising from them; metasomal terga shagreened as in *coreopsis*, but usually shinier; pygidial plate broadly V-shaped, rounded apex, about as broad at base as median length.

Hair: As in *M. nivea* except as follows: more abundant black hairs on vertex of head; mesoscutal dark patch extends forward beyond a transverse line at anterior margins of tegulae and to within one or two hairs of tegulae laterally; scutellum dark brown or black except for peripheral one or two hairs; tergum 2 with distal pale band usually narrower than apical area and often interrupted medially; terga 2 and 3 with apical areas with sparse, simple, appressed, dark brown to black hairs; terga 5 and 6 without lateral pale tufts; tergum 4 with apical fringe of dark brown hairs at least in median third; legs with fore and middle tarsi brown, outer surfaces of fore and middle tibiae brown distally, inner surfaces hind basitarsi dark brown to black, and scopal hairs pale ochraceous.

*Male.* Measurements and ratios: N, 15; length, 10-12 mm.; width, 3-4 mm.; wing length,  $M = 3.12 \pm 0.154$  mm.; hooks in hamulus,  $M = 11.20 \pm 0.175$ ; flagellar segment 2/segment 1,  $M = 10.05 \pm 0.699$ .

Structure and color: Integument black except as follows: Clypeus pale yellow to cream-colored with testaceous apical margin; labrum white with dark brown margin; mandibles with pale basal maculae similar in color to clypeus; eyes grayish blue to gray; wing membranes slightly infumate, veins dark brown; tegulae piceous;

flagellar segments 2 to 11 rufescent below; distitarsi rufescent; extremely narrow apical margin of tergum 1 hyaline or testaceous; terga 2-5 with apical areas piceous.

Structure as in *coreopsis* except as follows: first flagellar segment with minimum length equal to one-eighth or slightly less of maximum length second segment, third segment distinctly longer than three times minimum diameter, not crenulate, in repose surpassing pterostigma and even marginal cell; maxillary palpal ratio about 3.00:3.33:2.66:1.00, minute fifth segment often present. Sculpturing as in female except as follows: posteromedian mesoscutal punctures more crowded; tergum 1 with basal four-fifths punctate, punctures become progressively smaller and sparser as they approach narrow apical impunctate area; terga 2 and 3 with interband zone punctures smaller and sparser, apical areas virtually impunctate, surfaces shiny to moderately so. Pygidial plate slightly longer than broad. Terminalia as in *agilis* but sternum 8 with ventral tubercle pointed, not bidentate, and weak, and gonostyli with few hairs basally.

Hair: White except as follows: vertex of head dark brown; dark brown mesoscutal patch extends forward to a transverse line at anterior margins of tegulae and laterally to within 5 or 6 hair-rows of tegulae; scutellum dark brown except peripherally. Metasomal vestiture as in female except as follows: tergum 1 with apical third with progressively shorter, relatively simple, suberect to subappressed, dark brown hairs; terga 2 and 3 with distal pale bands somewhat narrower, rarely interrupted medially; tergum 4 similar to 3 but apical area reduced to narrow fringe of brown; tergum 5 with distal pale band reaching apex medially; terga 6 and 7 with dark brown hairs. Legs white except inner surfaces tarsi and hind tibiae yellow.

*Type Material.* The holotype male collected by T. B. Mitchell at Southern Pines, North Carolina, September 23, 1950, on *Kuhnistera* sp. is in the collection of T. B. Mitchell, North Carolina State College, Raleigh. The allotype female from Southern Pines, North Carolina, September 16, 1918, on *Gerardia flava* is in the collection of the American Museum of Natural History, New York City. Eighteen female and twelve male paratypes from North Carolina and collected by T. B. Mitchell are as follows: Aberdeen: 1 female and 1 male, September 10, 1923; 1 female and 1 male without floral data and 2 females on *Gerardia* sp., September 26, 1923; 1 female, October 15, 1957. Raleigh: 3 males in August (no further

collection data). Southern Pines: 2 females on *Gerardia* sp. and 1 female on *Liatris* sp., September 26, 1923; 1 male on *Kuhnistera pinnata*, September 15, 1949; 2 males on *Kuhnistera* sp., September 10, 1950; 1 female on *Chrysopsis* sp., September 23, 1950; 3 females without floral data, 1 female on *Aster* sp., and 1 female on *Kuhnistera* sp., September 30, 1951; 1 male, September 13, 1952; 1 female without floral data and 1 female on *Kuhnistera* sp., September 19, 1953; 2 females on *Chrysopsis* sp., October 15, 1957. Two female and three male paratypes from Southern Pines, North Carolina, were collected as follows: 2 males on *Aster* sp., August 20, 1918; 1 male, August 29, 1918; 2 females, September 13, 1918. Paratypes are in the collections of T. B. Mitchell, the American Museum of Natural History, the Snow Entomological Museum of the University of Kansas, Lawrence, and in the author's collection (Fig. 16).

*Melissodes (Eumelissodes) confusa* Cresson

*Melissodes confusa* Cresson, 1878, Proc. Acad. Sci. Philadelphia, vol. 30, p. 205; Cockerell, 1897, New Mexico Coll. Agr. and Mech. Arts, Bull. No. 24, pp. 20, 24; Birkman, 1899, Ent. News, vol. 12, p. 43; Bridwell, 1899, Trans. Kansas Acad. Sci., vol. 16, p. 211; Viereck, 1902, Trans. Amer. Ent. Soc., vol. 29, p. 46; Cockerell, 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 82, 92; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309; 1906, Bull. Amer. Mus. Nat. Hist., vol. 22, pp. 443, 454; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 137; Cockerell, 1910, Psyche, vol. 17, p. 246; 1911, Canadian Ent., p. 43, p. 33; Cresson, 1916, Mem. Amer. Ent. Soc., vol. 1, p. 116; Rau, 1922, Trans. Acad. Sci. St. Louis, vol. 24, p. 34; Cockerell, 1933, Ann. Ent. Soc. Amer. vol. 26, p. 44; Bohart, Knowlton and Bailey, 1950, Utah St. Agric. Coll. Mimeo. Ser. No. 371, p. 5.

*Melissodes ruidosensis* Cockerell, 1896, Entomologist, vol. 29, p. 305; 1898, Bull. Sci. Lab. Denison Univ., vol. 11, p. 66; 1898, Bull. Univ. New Mexico, vol. 1, p. 66; 1901, Ent. News, vol. 12, p. 43; 1901, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 130; 1902, Amer. Nat., vol. 36, p. 810; 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 12, p. 450.

*Melissodes tenuitarsis* Cockerell, 1905, Psyche, vol. 12, p. 99 (new synonymy); 1906, Trans. Amer. Ent. Soc., vol. 32, p. 76; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 137.

*Melissodes civica* Cockerell, 1910, Ann. Mag. Nat. Hist., ser. 8, vol. 5, p. 258 (new synonymy).

*Melissodes atraticornis* Cockerell, 1934, Amer. Mus. Nov. No. 697, p. 9 (new synonymy).

This species is highly variable in both sexes, a fact which makes it difficult to identify and has contributed to the synonymy. It is perhaps most closely related to *M. coreopsis*, but also shows some structural affinity to *M. grindeliae* and *M. rustica*. The female of *confusa* is similar to that of *coreopsis* but is darker in color as follows: terga 4 and 5 usually without pale lateral hair tufts, sternal hairs usually dark brown, often with lower and anterior surfaces of mesepisterna with brown hairs. In both sexes the antennae are often wholly black, although this is not so frequent in males as in



females. The female can be distinguished from that of *grindeliae* by the punctation of the basal area of tergum 2 as described below. The male has the short first flagellar segment of *coreopsis*, although often slightly longer, but has shorter antennae as a whole. The male clypeus varies in color from entirely yellow except the testaceous apical margin to almost entirely black. The basal area punctures of tergum 2 are sparse as in the female.

*Female.* Measurements and ratios: N, 20; length, 11-13 mm.; width, 3.5-5.0 mm.; wing length,  $M = 3.54 \pm 0.211$  mm.; hooks in hamulus,  $M = 12.70 \pm 0.219$ ; flagellar segment 1/segment 2,  $M = 1.86 \pm 0.013$ .

Structure and color: Integument as in *coreopsis* except as follows: distitarsi black to dark red; eyes gray to dark gray; flagellar segments 3 to 10 dark reddish brown to black below, second segment entirely dark; wing membranes somewhat infumate, brownish yellow; veins black to dark brown; tibial spurs yellowish to red.

Sculpturing and structure of head and thorax as in *coreopsis* except as follows: clypeus slightly protruding forward beyond eyes, oculoclypeal distance half to three-fourths minimum width of first flagellar segment, punctures slightly more coarse; supraclypeal area usually with surface shiny, unshagreened; maxillary palpal ratio about 3.0:2.7:2.0:1.0. Metasomal tergum with basal three-fifths or slightly less with shallow, medium-sized punctures separated mostly by half to two puncture widths, apical zone extended to form anterolateral impunctate lobes; tergum 2 with basal area punctures round, small, deep, separated by one to two puncture widths or slightly more, surface unshagreened or with delicate reticular shagreening, apical area with small punctures about twice diameter of hairs arising from them, surface dulled by reticulotransverse shagreening, but moderately shiny to shiny. Pygidial plate broadly V-shaped with rounded apex, length subequal to basal width to slightly longer.

Hair: Head as in *coreopsis*. Thorax as in *coreopsis* except as follows: pale hairs ochraceous above, white to pale ochre laterally; mesepisterna with anterior, ventral and lower lateral surfaces usually dark brown; posteromedian dark mesoscutal patch twice as large as scutellar dark patch or larger, usually almost reaching tegulae laterally and extending forwards beyond a transverse line at anterior margins of tegulae; tegulae with dark hairs. Metasomal tergum 1 with basal area white to ochraceous, often quite yellow, apical area with minute, closely appressed, brown hairs at least

basally; tergum 2 with distal pale pubescent band pale ochraceous to yellowish, usually reaching apex of tergum laterally, shorter medially but rarely interrupted, interband zone with abundant, erect to suberect, dark brown hairs, apical area with abundant, suberect to subappressed, dark brown, relatively simple hairs in basal two-thirds; tergum 3 as tergum 2 but basal area dark brown, distal pale band longer and reaching apex in lateral thirds or more; tergum 4 as in *coreopsis*; terga 5 and 6 without lateral pale tufts; sterna reddish brown to dark brown. Legs ochraceous except as follows: distitarsi, fore and middle basitarsi brown or largely so; middle basitarsi with inner surface dark reddish; hind basitarsi with inner surfaces reddish brown to black; scopal hairs often yellowish; basitibial plates, outer apical surfaces fore and middle tibiae brown; hind tibiae with inner surfaces yellow to dark red.

*Male.* Measurements and ratios: N, 20; length, 9-12 mm.; width, 2.5-4.0 mm.; wing length,  $M = 3.51 \pm 0.156$  mm.; hooks in hamulus,  $M = 12.10 \pm 0.169$ ; flagellar segment 2/segment 1,  $M = 6.08 \pm 0.163$ .

Structure and color: Integumental color as in *coreopsis* except as follows: clypeus varies from yellow with testaceous apical margin and dark maculae at tentorial pits to entirely black, most often yellow with dark brown apical margin and infuscated along posterior margin between and slightly beyond tentorial pits; labrum and mandibles black; eyes dark gray to yellowish green; flagellum varies from red below and dark brown above with first segment entirely dark to entire flagellum dark brown or black, most often with first segment, base of second segment, tip of last segment and upper surfaces dark brown and red below; wing membranes slightly infumate, yellowish; veins dark brown to black; metasomal terga with apical areas hyaline, yellowish brown to yellow, not rufescent basally; distitarsi rufescent; tibial spurs yellow.

Clypeus much as in female; first flagellar segment with minimum length equal to almost half maximum length and equal to about one-eighth maximum length second segment, penultimate segment one-third as wide as long or slightly broader, just reaching pterostigma or slightly less in repose, flagellum somewhat crenulate near apex in lateral view (involving penultimate three to five segments); maxillary palpal ratio about 2.7:1.7:2.0:1.0. Sculpturing as in female except as follows: mesoscutal punctures often more crowded; metasomal tergum 1 with basal four-fifths punctate; terga 2 and 3 with interband zone punctures more distinct and often slightly

larger, apical area punctures minute or absent; tergum 2 with basal area punctures minute, separated by two to four puncture widths and mostly by three or four widths; sterna shiny; reticular shading coarse, often absent medially. Terminalia as in *M. agilis*, but sternum 8 with abundant apical hairs and with apicomedial tuft of hairs just above ventral tubercle, tubercle acute, not bidentate.

Hair: Head and thorax pale to dark ochraceous, paler laterally, head often with brown on vertex, mesoscutum often with dark brown patch posteromedially, scutellum usually with at least a few brown hairs, tegulae usually with brown. Metasomal tergum 1 pale to dark ochraceous except two or three subapical rows of shorter, relatively simple, dark brown hairs; tergum 2 pale ochraceous to white basally, distal band ochraceous, arched medially but usually not interrupted, basal and distal bands connected laterally, interband zone hairs suberect to erect, yellow to dark brown, apical area hairs subappressed to suberect, dark brown to ochraceous (usually at least apical few rows dark); terga 3 and 4 similar but basal tomentum brown, interband zone hairs more often and mostly dark brown, apical areas progressively shorter; tergum 5 like tergum 4 but distal pale band apical; terga 6 and 7 entirely dark brown to dark medially and ochraceous to light brown laterally. Legs ochraceous except yellowish orange on inner surfaces tarsi and basitibial plates brown.

*Bionomics.* The floral data for this species are sparse, but they indicate the usual oligolecty of the subgenus *Eumelissodes*, that is, a preference for flowers of the family Compositae as pollen sources. A wide variety of composites are visited, however, and it is difficult to state any preference on the basis of the present data. However, *M. confusa* is unusual in that it has not yet been collected visiting flowers of *Helianthus*. Also, the author has collected males on more than one occasion (especially in Mexico) sleeping in the flowers of *Argemone* (Papaveraceae), but no females have been taken from this flower. Table VIII below summarizes the floral data.

*Type Material.* Lectotype female and lectoallotype male of *confusa*, both from Colorado, are in the Academy of Sciences of Philadelphia, Pennsylvania. Cockerell apparently did not designate a holotype for his *M. ruidosensis*. However, I have seen several specimens labeled *ruidosensis* in Cockerell's handwriting and Lutz and Cockerell synonymize *ruidosensis* with *confusa* in their catalogue (1920). Two males labeled as cotypes of *ruidosensis* were



TABLE VIII. Summary of Floral Records for *Melissodes confusa*.

Plant Data			Records of <i>M. confusa</i>			
FAMILY	Number of genera	Number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae:						
<i>Cirsium</i> spp.	1	2	15	19	27	46
<i>Helenium</i> spp.	1	3	8	21	70	90
<i>Grindelia</i> sp.	1	1	9	11	1	12
Other Genera	14	19	27	39	17	56
Leguminosae	4	4	8	3	8	11
Labiatae	3	3	5	5	3	8
Geraniaceae	1	1	4	6	2	8
Other Families (7)	7	7	9	5	13	18
Totals	32	40	83	109	141	250

found in the collection of the U. S. National Museum, Washington, D. C. I hereby designate one of these (Cotype No. 3361) as the lectotype male of *ruidosensis*. This male also bears the label "Wooton 111." The holotype male of *tenuitarsis* from Oak Creek Canyon, Arizona, collected by F. H. Snow, is in the Snow Entomological Museum of the University of Kansas, Lawrence. The female holotype of *civica*, collected by Farrar at Mexico City, Mexico, is in the Zoologische Museum der Humboldt Universität, East Berlin, Germany. The holotype male of *atraticornis* from Pingree Park, Colorado, collected by Louise Ireland on August 14, 1933, is in the Academy of Sciences of Philadelphia, Pennsylvania.

*Distribution.* *M. confusa* ranges from southern Canada to central Mexico and from California to Wyoming and Minnesota (Fig. 18). It has been taken from June 23 to September 21, but chiefly during July and early August in the United States, and as late as December 11 in central Mexico. A total of 272 females and 570 males have been examined from localities listed below. As this species has in the past been confused with several other species, only those published records which have been verified by the author



FIG. 18. Map showing the known distribution of *M. (Eumelissodes) confusa* Cresson.

are included in the list. This omits certain dubious records in Kansas, Missouri, Texas and Illinois.

ARIZONA: Baboquivari Mts.; Barfoot Camp Grounds, Chiricahua Mts.; Deer Park, Chiricahua Mts.; Flagstaff (and 4 miles N., 7 miles S. and 6 miles W.); Globe; Graham Mts.; Grand Canyon; Hospital Flat, Pinaleno Mts.; Houserock Canyon; Humphrey's Peak; Kaibab Forest; Leukachuka Mts.; McNary; Madera Canyon, Santa Rita Mts.; Mt. Lemmon, Santa Catalina Mts.; Oak Creek Canyon; Onion Saddle, Chiricahua Mts.; Paradise (4 miles W.), Chiricahua Mts.; Ramsey Canyon, Huachuca Mts.; Rustler's Park, Chiricahua Mts.; San Francisco Mt.; Santa Catalina Mts.; Sierritas (Black Dike Prospect); Vail Lake; White Mts.; Williams. CALIFORNIA: Big Bear Lake, San Bernardino Co.; Huntington Lake, Fresno Co.; Little Pine Valley, Mono Co.; Yosemite Valley. COLORADO: Aspen; Boulder; Buena Vista; Chimney Gulch (Golden); Cimarron; Colorado Springs; Costillo; Creede; Estes Park; Florissant; Gilpin (Lump Gulch); Glen Haven; Jim Creek (near Boulder); Leadville; Manitou Park; Meeker; Mesa Verde; Monument Lake; Ouray; Pagosa Springs; Peaceful Valley; Pingree Park; Ridgway; Rosa Mts.; San Luis Valley; San Miguel Mts., Wilson Peak; St. Vimis Creek (above Peaceful Valley); Tolland; Villa Grove; Ward; Westcliff. MINNESOTA: Ada; Alma Township (east of Argyle); Hastings; Kittson Co.; Middle River; Plummer; Red Lake Co.; Roseau Co. NEVADA: Charleston Peak, Clark Co.; Kyle Canyon, Charleston Mts. NEW MEXICO: Albuquerque; Beulah; Dripping Springs, Organ Mts.; Las Vegas; Ruidoso Creek; Santa Fe; Sapello; Sapello Canyon; White Mts. (several locales in, including Rio Ruidoso); Willow Canyon. NORTH DAKOTA: Fargo; Grand Forks; Granville; Jarves Lake, Turtle Mts.; Kensal; Dakota; Minot; Mylo; Nicholson; Stanley; Perth; Wales. UTAH: Escalante (15 and 22 miles N.); Glendale; Heber (12 miles S. E.); Kanab; Ogden; Mt. Timpanogos. WYOMING: Summit; University of Wyoming Summer Camp. *Canada.* ALBERTA: Lethbridge. MANITOBA: Shoal Lake; Teulon; Transcona. SASKATCHEWAN: Earl Grey; Saskatoon; Swift Current. *Mexico.* BAJA CALIFORNIA: ?"BC"? CHIHUAHUA: Minaca (22 miles S.). COAHUILA: Buena Vista (Sierra del Carmen). DISTRITO FEDERAL: Atlacomulco; Toluca (20 miles E.; 22 miles N.). DURANGO: Coyote; El Salto (and 6 miles N. E., and 25 miles S. W.); Palos Colorados. HIDALGO: Pachuca (and 16 miles E.). MICHOACAN: Tancitaro. MORELOS: Cuernavaca (19 miles N.). OAXACA: Monte Alban. VERACRUZ: Jalapa (13 miles N. W.); Perote (9 miles N.).



*Flower Records.* *Agoseris glauca*, *Aplopappus* sp., *Argemone* sp., *A. platyceras*, *Aster* sp., *A. canescens*, *Bidens triplinervia* var. *macracantha*, *Ceanothus* sp., *Cirsium* sp., *C. undulatum*, *Cleome* sp., *Cosmos parviflorus*, *Erigeron* sp., *E. uniflorus*, *Eryngium asperum*, *Gaillardia* sp., *Geranium* sp., *G. atropurpureum*, *Grindelia* sp., *G. squarrosa*, *Helenium* sp., *H. bigelovii*, *H. hoopseii*, *Heliopsis scabra*, *Lactuca pulchella*, *Lotus* sp., *Medicago sativa*, *Monarda* sp., *M. pectinata*, *Penstemon* sp., *Petalostemum purpureum*, *Phacelia* sp., *Polymenantha* sp., *Ratibida columnaris*, *Rudbeckia* sp., *R. hirta*, *R. lacinita*, *Senecio bigelovii*, *S. purchianus*, *Solidago* sp., *S. trinervata*, *Teucrium occidentale*, *Verbena stricta*, *Verbesina* sp., *V. enceliodes*, *Vicia* sp., *V. pulchella*.

*Melissodes (Eumelissodes) montana* Cresson

*Melissodes montana* Cresson, 1878, Proc. Acad. Nat. Hist. Philadelphia, vol. 30, p. 202; Townsend, 1896, Canadian Ent., vol. 28, p. 139; Cockerell, 1896, Entomologist, vol. 29, p. 308; 1897, Entomologist, vol. 40, pp. 21, 24, 28; 1897, New Mexico Coll. Agric. and Mech. Arts, Bull. No. 24, p. 21; 1898, Bull. Sci. Lab. Denison Univ., vol. 11, p. 66; Bull. Univ. New Mexico, vol. 1, p. 66; Birkman, 1899, Ent. News, vol. 10, p. 245; Viereck, 1903, Proc. Acad. Nat. Sci. Philadelphia, vol. 54, p. 728; Cockerell, 1903, Psyche, vol. 10, p. 77; 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 78, 88, 92; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 137; Cresson, 1916, Mem. Amer. Ent. Soc., vol. 1, p. 124.

*Melissodes hirsuta* Smith, 1879, Desc. new species in the Collection of the British Museum, p. 116 (new synonymy); Cockerell, 1905, Trans. Amer. Ent. Soc., vol. 31, p. 328.

*Melissodes atrifera* Cockerell, 1910, Ann. Mag. Nat. Hist., ser. 8, vol. 5, p. 256 (new synonymy).

*Melissodes atrifera sandiarum* Cockerell, 1910, Ann. Mag. Nat. Hist., ser. 8, vol. 5, p. 257 (new synonymy); 1911, Trans. Amer. Ent. Soc., vol. 37, p. 239.

*M. montana* is closely related to *M. coreopsis* from which it is difficult to distinguish, especially in the female sex. The female of *montana* is slightly darker than that of *coreopsis*, has black wing veins, and has red to reddish brown hairs on the inner surfaces of the hind basitarsi. The flagellum tends to be entirely black or dark brown below, as well as above, unlike the paler flagellum of *coreopsis*. The male differs from that of *coreopsis* by having abundant dark hairs on the abdomen, and usually on the mesoscutum, scutellum, tegulae and vertex of the head. *M. montana* is also related to *M. confusa* from which it can be separated in both sexes by the more coarse and crowded punctures at the base of the second metasomal tergum. In addition the female of *montana* usually has tufts of pale hairs at the sides of tergum 5 and often tergum 6 and apically across the penultimate sternum.

*Female.* Measurements and ratios: N, 20; length, 11-14 mm.; width, 4.0-4.5 mm.; wing length,  $M = 3.65 \pm 0.133$  mm.; hooks in

hamulus,  $M = 13.90 \pm 0.204$ ; flagellar segment 1/segment 2,  $M = 1.85 \pm 0.028$ .

Structure and color: Integument as in *coreopsis* except as follows: basitarsi and tibiae not rufescent; flagellar segment 3 often brown below and segments 4 to 10 often entirely dark; eyes greenish gray to dark gray; wing membranes slightly infumate to slightly milky, veins black to dark brown; tegulae piceous; tergum 1 with apical margin narrowly hyaline, not rufescent basally.

Clypeus and sculpturing as in *coreopsis* with the following differences: clypeal punctures often coarser, crowded; supraclypeal area often shiny and unshagreened; maxillary palpal ratio about 2.7:2.0:1.7:1.0. Mesoscutal punctures of posteromedian area separated mostly by one to two puncture widths; mesepisternal punctures about equal in size to posteromedial mesoscutal punctures, separated mostly by half a puncture width. Metasomal tergum 1 with basal area punctures separated mostly by one puncture width; tergum 2 with basal area with small round punctures separated mostly by one puncture width, often less, surface usually slightly dulled by reticular shagreening; interband zone punctures small, separated mostly by two puncture widths, apical area impunctate or with minute punctures in basal half; pygidial plate distinctly longer than basal breadth.

Hair: In general as in *coreopsis* with the following differences: mesoscutal dark patch usually larger, usually twice as large as scutellar dark patch or larger, pale hairs anterior to dark patch usually dark ochraceous; tegulae with abundant dark brown hairs; mesepisterna occasionally with a few light brown hairs ventrally; metasomal tergum 1 with apical area and anterolateral impunctate lobes usually with short, relatively simple, closely appressed brown hairs; tergum 2 with interband zone hairs short, subappressed to erect, apical area with short subappressed, dark brown hairs, pale distal band often not notched medially, usually at least notched and interrupted when worn, not reaching apex of tergum laterally; tergum 3 with distal pale band often reaching tergum laterally; tergum 5 almost always and tergum 6 often with small pale lateral tufts; sterna dark reddish brown, often pale laterally, penultimate sternum with apical fringe of ochraceous to white hairs; distitarsi often brown (especially anterior); anterior and middle basitarsi with outer surfaces brown (midbasitarsi occasionally ochraceous); scopal hairs pale to bright ochraceous; inner surfaces hind basitarsi red to reddish brown, usually paler than in either *coreopsis* or *confusa*.

*Male.* Measurements and ratios: N, 20; length, 10-13 mm.; width, 2.5-4.0 mm.; wing length,  $M = 3.45 \pm 0.138$  mm.; hooks in hamulus,  $M = 12.10 \pm 0.240$ ; flagellar segment 2/segment 1,  $M = 6.67 \pm 0.186$ .

Structure and color: Integument as in *coreopsis* except as follows: eyes usually greenish gray; clypeus yellow with anterior margin brown to testaceous; labrum and mandibles black, rarely with mediobasal pale labral spot; first flagellar segment brown; wing membranes often slightly infumate, veins deep reddish brown to black; apical tergal areas hyaline, yellowish, not rufescent basally.

Clypeus as in female; first flagellar segment as in *coreopsis* but slightly longer, penultimate segment longer than three times width, flagellum surpassing pterostigma in repose; maxillary palpal ratio about 4.0:2.5:3.0:1.0. Sculpturing as in female except as follows: tergum 1 with basal three-fifths or more punctate, punctures progressively smaller distally; terga 2-4 with interband zone punctures slightly coarser and with distal area impunctate; apices of terga moderately shiny; sterna as in *coreopsis*. Terminalia as in *M. agilis*.

Hair: White to pale ochraceous except as follows: vertex of head usually with a few to many brown hairs; mesoscutum usually with brown hairs posteromedially, often abundant; tegulae often with brown hairs; scutellum almost always with a few brown medially; terga 1-4 usually with subappressed to suberect, relatively simple, brown hairs apically; interband zones of terga 3-5 and usually 2 with abundant suberect to erect brown hairs; terga 6 and 7 usually brown or golden brown; sterna brown to red medially, paler laterally; legs with inner surfaces tarsi and hind tibiae yellow to orange.

*Remarks.* *M. montana* has in the past been confused with *M. coreopsis*, *M. confusa* and *M. grindeliae*, especially in the female sex. Females are still difficult to separate from those of *coreopsis*, although excellent characters will differentiate them from *confusa* and *grindeliae*. If the males of *montana* and *coreopsis* were not so distinct, and if the two forms did not overlap over so large a territory without intergrading, one would be tempted to consider one as the subspecies of the other. It is perhaps significant that where *montana* is abundant *coreopsis* is quite rare, with the possible exception of Colorado wherein both species are reasonably abundant.

This species is an oligolege of the Compositae like most other *Eumelissodes*. Of 34 collections (48 females and 22 males) with floral data, 26 collections (35 females and 13 males) are from some



composite. Not enough data are available for more complete analysis than this.

*Type Material.* Lectotype female of *montana* from Colorado is in the collection of the Academy of Sciences of Philadelphia. A female paratype deposited with the lectotype is actually *M. grindeliae* and two male paratypes with the latter are both *M. gilensis*. The male holotype of *atrifera*, collected in Mexico by Deppe, is in the collection of the Zoologische Museum der Humboldt Universität, East Berlin, Germany. The holotype of *atrifera* has the clypeus wholly infuscated. The holotype male of *atrifera sandiarum*, from the Sandia Mts., New Mexico, collected on *Croton* sp., July 26, 1909, is in the collection of P. H. Timberlake at the Citrus Experiment Station, Riverside, California.

*Distribution.* This species is known from Colorado and Utah south to Oaxaca and Baja California in Mexico (Fig. 17). It has been collected from June 26 to October 14, but chiefly in August and September. The following list includes all localities from which the author has examined specimens; published records not verified are omitted. A total of 136 females and 134 males have been examined.

ARIZONA: Baboquivari Mts.; Canelo; Carr Canyon, Huachuca Mts.; Chiricahua National Monument; Douglas; Flagstaff; Ganado; Mt. Graham; Grand Canyon; Grand Canyon Junction (4 miles N.); Houserock Canyon; Lochiel (4 miles E.); Madera Canyon, Santa Rita Mts.; Miller Canyon, Huachuca Mts.; Oak Creek Canyon; Onion Saddle, Chiricahua Mts.; Painted Canyon, Cave Creek, Chiricahua Mts.; Palmerlee; Pima Co.; Portal (5 miles W.); Prescott; Ramsey Canyon, Huachuca Mts.; Rustler's Camp, Chiricahua Mts.; Sabino Canyon, Santa Catalina Mts.; San Francisco Mt.; Santa Rita Mts.; Sedona (15 miles N.); Sunnyside Canyon, Huachuca Mts.; Todd's Lodge, Oak Creek Canyon; Walnut Canyon (near Flagstaff). COLORADO: Boulder Canyon; Chimney Gulch; Colorado Springs; Jim Creek (near Boulder); Manitou; Peaceful Valley; Rock Creek, Teller Co. NEW MEXICO: Beulah; Hollywood; Las Vegas; Magdalena Mts.; Organ Mts.; Pecos; Sandia Mts. TEXAS: Big Bend National Park. UTAH: Beaver Ridge Mts.; Big Cottonwood Canyon, Wasatch Mts. (near Bench); Bluff. MÉXICO. AGUASCALIENTES: Aguascalientes (30 miles N.); Rincon de Romos (12 km. N.). BAJA CALIFORNIA: La Laguna, Sierra Laguna. CHIHUAHUA: Minaca (22 miles S.); Ojito (36 km. from Santa Barbara); Salaíces; Santa Barbara. COAHUILA: Cabos. DURANGO: Coyotes; El Salto (6 miles

N. E.); Nombre de Dios; Otinapas; Palos Colorados; San Juan del Río; Villa Ocampo; Yerbanis (Cuencame District). GUANAJUATO: Leon (7 miles N. W.). HIDALGO: Actopán; Huichapán (7 miles S. W.); Ixmiquilpan (19 miles W.); Pachuca. JALISCO: Jalostotitlan (6 miles N. E.). OAXACA: Nochixtlan (7 miles S. E.); Oaxaca; Tamazulapan (4 miles S. E.). PUEBLA: Puebla; Tepanco de Lopez (4 miles N. W.). SAN LUIS POTOSÍ: Ciudad del Maiz (13 miles N. W.). ZACATECAS: Canutillo; Fresnillo (and 9 miles S. E.); Sain Alto; Sombrerete (15 km. E.).

*Flower Records.* *Aplopappus gracilis*, *Asclepias* sp., *Aster* sp., *A. commutatus*, *Croton* sp., *Erigeron* sp., *Eriogonum* sp., *Grindelia* sp., *Gutierrezia* sp., *Helianthus* sp., *H. annuus*, *Heterotheca subaxillaris*, *Polymenantha* sp., *Senecio longilobus*, *Verbesina exauriculata*.

### *Melissodes (Eumelissodes) tristis* Cockerell

*Melissodes tristis* Cockerell, 1894, Ent. News, vol. 5, p. 234; 1896, Entomologist, vol. 29, p. 304; 1897, New Mexico Coll. Agric. and Mech. Arts, Agric. Bull. No. 24, p. 23; 1898, Bull. Sci. Lab. Denison Univ., vol. 11, p. 66; 1898, Bull. Univ. New Mexico, vol. 1, p. 66; 1899, Entomologist, vol. 32, p. 156; 1900, Entomologist, vol. 32, p. 218; 1901, Ent. News, vol. 12, p. 40; 1902, Entomologist, vol. 35, p. 177; 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 75, 92; Viereck, 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 238, 240; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 137; Cockerell, 1907, Ent. News, vol. 18, p. 397; 1923, Proc. U. S. Nat. Mus., vol. 63, p. 3; 1925, Ann. Mag. Nat. Hist., ser. 9, vol. 16, p. 229; Cresson, 1928, Mem. Amer. Ent. Soc., vol. 5, p. 71; Sperry and Andrews, 1937, Bull. S. California Acad. Sci., vol. 36, p. 108; Bohart, Knowlton and Bailey, 1950, Utah St. Agric. Coll., Mimeo. Ser. No. 371, p. 5.

*Melissodes pallidicincta* Cockerell, 1896, Entomologist, vol. 29, p. 306; 1897, New Mexico Coll. Agric. and Mech. Arts, Agric. Bull. No. 24, p. 20; 1898, Bull. Sci. Lab. Denison Univ., vol. 11, p. 67; 1898, Bull. Univ. New Mexico, vol. 1, p. 67; 1901, Ent. News, vol. 12, pp. 40, 43; 1901, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 130; 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 12, p. 449; 1904, Entomologist, vol. 37, p. 8; 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 88, 92, 109; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309; 1906, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 443; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 137; Cockerell, 1907, Ent. News, vol. 18, p. 397; 1907, Univ. Colorado Studies, vol. 4, p. 255; Bray, 1917, Pomona Jour. Ent. Zoo., vol. 9, p. 94; Cockerell, 1925, Ann. Mag. Nat. Hist., ser. 9, vol. 16, p. 229; 1928, Univ. Colorado Studies, vol. 16, p. 114.

*Melissodes tristis* var. *malvina* Cockerell, 1902, Entomologist, vol. 35, p. 177.

*Melissodes semitristis* Cockerell, 1905, Psyche, vol. 12, p. 102 (new synonymy); 1906, Trans. Amer. Ent. Soc., vol. 32, p. 75; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 137.

*Melissodes pallidicincta* var. *erythrina* Cockerell, 1925, Ann. Mag. Nat. Hist., ser. 9, vol. 16, p. 231; 1928, Univ. Colorado Studies, vol. 16, p. 114.

*M. tristis* is a distinctive species not closely related to any of the foregoing species, but perhaps most closely to *M. coreopsis*. The males are distinctive in having a completely black clypeus, pale eyes, pale and extremely long flagella, and opaque-white pubes-

cence. The female has a wider clypeus than usual with a marked shiny boss anteromedially, generally white or pale ochraceous pubescence, and a broad, hyaline, colorless, apical margin on the first tergum.

*Female.* Measurements and ratios: N, 20; length, 10-14 mm.; width, 3.5-5.0 mm.; wing length,  $M = 3.88 \pm 0.182$  mm.; hooks in hamulus,  $M = 13.25 \pm 0.190$ ; flagellar segment 1/segment 2,  $M = 1.86 \pm 0.086$ .

Structure and color: Integument black except as follows: distitarsi and apical half of mandibles rufescent; flagellar segments 3 to 10 and often apex of 2 red below; eyes bluish to greenish gray; wing membranes colorless, often milky, veins reddish brown to black; tegulae piceous; metasomal tergum 1 with apical eighth hyaline, colorless, often slightly rufescent basal to hyaline area; terga 2-4 often with apical areas slightly rufescent; tibial spurs white.

Clypeus flat, broad and short, oculoclypeal distance equals almost three-fourths minimum diameter first flagellar segment and usually more than one-half, with pronounced, shiny, apicomedial boss, coarsely and irregularly punctate lateral to boss with punctures separated mostly by half a puncture width, surface shiny, unshagreened or delicately so; supraclypeal area coarsely punctate, shiny; vertex with lateral area punctures minute, separated mostly by 3 or 4 puncture widths; maxillary palpal ratio about 3.0:2.7:2.0:1.0. Thoracic sculpturing as in *coreopsis* but posteromedial mesoscutal punctures sparse, separated mostly by one to three puncture widths and with a small impunctate area, surface shiny, rarely shagreened. Abdomen as in *coreopsis* except as follows: tergum 1 with basal area punctures extremely small and shallow, separated mostly by one to three puncture widths; tergum 2 with basal area punctures separated by more than one puncture width and often by two or more widths, interband zone impunctate or with sparse punctures of irregular size, apical area impunctate, surface dulled by fine reticulotransverse shagreening except shiny basal area; tergum 3 similar but interband zone punctures more abundant; pygidial plate V-shaped, side slightly concave to slightly convex, slightly broader at base than median length, apex rounded.

Hair: Head white, often with sparse brown on vertex. Thorax pale ochraceous above, white on sides, scutellum brown medially, mesoscutum with brown posteromedian patch not much larger than scutellar brown patch, if any. Metasomal tergum 1 with basal



hairs white; tergum 2 with basal and distal pubescent bands white and broadly connected at sides, interband zone with short suberect brown hairs but these sparse, distal band not reaching apex, scarcely notched medially, thick, apical area glabrous or with sparse, subappressed, short, simple, brown hairs; tergum 3 similar but basal tomentum brown, apical area with more abundant brown; tergum 4 with apical white band uninterrupted; terga 5 and 6 dark brown, without lateral pale tufts; sterna dark brown. Legs white except as follows: basitibial plates, inner surfaces basitarsi (including hind), outer surfaces fore basitarsi, and often distitarsi dark reddish brown.

*Male.* Measurements and ratios: N, 20; length, 9-12 mm.; width, 2.5-4.0 mm.; wing length,  $M = 3.56 \pm 0.239$  mm.; hooks in hamulus,  $M = 12.10 \pm 0.204$ ; flagellar segment 2/segment 1,  $9.55 \pm 0.249$ .

Structure and color: Integument black except as follows: eyes greenish to bluish gray; apical half of mandible and distitarsi rufescent; flagellum reddish yellow to yellow beneath except first segment often all reddish brown and black above; wing membranes as in female, veins dark red to reddish brown; metasomal terga with hyaline, colorless apices, rarely slightly yellowed, often somewhat rufescent basal to hyaline areas; tegulae piceous; tibial spurs white.

Clypeus as in female but narrower, strongly converging towards mandibles, boss often less distinct; first flagellar segment with minimum length usually at least two-thirds maximum length and usually about equal to one-tenth maximum length of second segment, penultimate segment longer than three times minimum width, flagellum in repose reaching apex of marginal cell or almost; maxillary palpal ratio about 4.5:3.5:3.0:1.0. Sculpturing as in female except as follows: clypeal punctures smaller; mesoscutal punctures larger and usually more crowded posteromedially; tergum 1 with basal three to four-fifths punctate; tergum 2 with basal area punctures larger, separated mostly by one puncture width or less; terga 2, 3 and 4 with distinct round interband zone punctures. Terminalia as in *M. agilis* but gonostylus elbowed near base and median plate of sternum 7 with inner margin sinuate, not with distinct angle below (Figs. 86-89).

Hair: White except often extremely pale ochraceous on dorsum of thorax and vertex of head; thorax and head without brown; metasomal terga without brown except occasionally at extreme base of terga 3-6; tergum 2 with interband zone with bristlelike hairs

suberect and long, distal pubescent band thick, as long or longer than apical area medially; terga 2-4 with apical areas glabrous or with subappressed, simple white hairs; tergum 1 with thick, appressed, white, apical pubescence only in lateral fourths, long basal hairs subappressed near apex and reaching or surpassing apex medially unless worn; inner surfaces hind basitarsi yellow.

*Bionomics.* This species is widely distributed in southwestern United States and Mexico. From the collection data available, *M. tristis* seems to have three generations per year in Texas, New Mexico and Arizona. It probably has fewer than three to the north and perhaps more than three to the south of this area. The first peak of abundance in the southern Texas-Arizona area occurs in the

TABLE IX. Summary of Floral Records for *Melissodes tristis*.

Plant Data			Records of <i>M. tristis</i>			
FAMILY	Number of genera	Number of species	Number of collections	Number of females	Number of males	Total number of bees
Leguminosae:						
<i>Melilotus</i> spp.	1	2	27	88	181	269
<i>Medicago</i> sp.	1	1	23	31	8	39
<i>Larrea</i> spp.	1	2	11	104	0	104
Other genera	11	15	22	68	25	93
Compositae:						
<i>Gaillardia</i> spp.	1	3	28	53	36	89
<i>Helianthus</i> spp.	1	3	26	18	62	80
<i>Aster</i> spp.	1	3	13	11	3	14
Other genera	26	34	67	76	107	183
Malvaceae	4	9	57	198	31	229
Caetaceae	1	4	20	37	9	46
Hydrophyllaceae	1	2	9	54	9	63
Brassicaceae	5	6	19	31	18	49
Other families (29)	39	47	105	145	253	398
Totals	93	131	424	881	750	1,631

latter part of April and the first half of May. The second and the greatest peak of abundance occurs in early to middle July. The third and least peak occurs in the first half of September.

A species of *Melissodes* which has several generations per year and which can thus be found visiting flowers from early March until early November, can be assumed to be polylectic to a certain degree. This is true of *tristis*. It is the most polylectic of all of the species of the subgenus *Eumelissodes*. It seems to prefer plants of the families Leguminosae, Compositae and Malvaceae in that order. Thus, *M. tristis* is one of the few *Eumelissodes* which does not show a strong predilection for composites as pollen sources. On the contrary, the collection data indicate that composites should be placed third as sources of pollen, if the ratio of females to males is indicative of such a preference, as the author assumes it to be. The available floral data for *M. tristis* are summarized below in Table IX. Note the great variety of plants visited as shown by the numbers of families, genera and species.

*Type Material.* Holotype male of *tristis* from Las Cruces, New Mexico, August 2, is in the collection of the Academy of Natural Sciences of Philadelphia, Pennsylvania. Lectotype female, here designated, of *pallidicincta*, from West Fork Gila River, New Mexico, July 16, is in the collection of the U. S. National Museum, Washington, D. C. (USNM No. 3357). Holotype male of *tristis malvina* from Cerro Chilicota, Chihuahua, Mexico, March 22, C. H. T. Townsend, is in the collection of the Museum of Natural History, University of Colorado, Boulder. Holotype male of *semitristis* from Oak Creek Canyon, Arizona, July, F. H. Snow, is in the Snow Entomological Museum, University of Kansas, Lawrence. Holotype female of *pallidicincta erythrina* from Colorado Springs, Colorado, June 15-30, 1896, H. F. Wickham, is in the collection of the American Museum of Natural History, New York City.

*Distribution.* *M. tristis* ranges from Nebraska, Colorado, Utah, Nevada, and California, south to southcentral Mexico (Fig. 19). It has been collected from March 14 to November 4, but chiefly in early July. A total of 1,707 females and 1,673 males have been examined from the localities recorded below. Published records are included only when verified by the author.

ARIZONA: Amado; Apache Junction; Aquila; Arivaca; Ashfork; Benson; Bill Williams' Fork; Bisbee; Bonita (Stewart Lake); Bowie; Cameron; Camp Verde (5 miles S. E.); Canelo; Carr Canyon, Huachuca Mts.; Carr Peak, Cochise Co.; Carrizo Creek; Casa



Grande; Catman (Cat Mt.?); Cave Creek, Chiricahua Mts.; Chambers (3 miles W.); Chandler; Chino Valley; Cochise Co.; Continental; Cornville; Dewey; Dona; Douglas; Drake (4 miles N.); Duncan; Duquesne; Elfrida; Elroy; Fish Creek, Tonto National Forest; Flagstaff; Fort Huachuca; Gila Bend (25 miles E.); Globe; Graham Mts.; Grand Canyon; Granite Dells; Gray Mt. (10 miles W.), Coconino Co.; Groom Creek; Harshaw; Holbrook; Jerome;



FIG. 19. Map showing the known distribution of *M. (Eumelissodes) tristis* Cockerell.

Kansas Settlement; Kayenta; Kingman; Kirkland (Peoples Valley); Lochiel; Madera Canyon, Santa Rita Mts.; Marana; McNeal; Mesa; Millers Canyon, Huachuca Mts.; Mt. Lemmon (Molino Basin); Mt. View (6 miles S.); Nicks, Huachuca Mts.; Oak Creek Canyon; Onion Saddle, Chiricahua Mts.; Oracle; Painted Canyon Ranch, Chiricahua Mts.; Paradise, Chiricahua Mts.; Patagonia Mts.; Payson; Peach Springs; Pearce; Petrified Forest; Phoenix; Picacho; Pima (3 miles S.); Pinal Mts.; Portal (5 miles W. at S. W. Research Station); Prescott; Ramsey Canyon, Huachuca Mts.; Roosevelt Lake; Rustlers Park, Chiricahua Mts.; Safford; Saint David; Salt River Bridge (near Seneca); San Bernardino Valley, Chiricahua Mts.; San Francisco Mts.; San Simon; Santa Catalina Mts.; Sedona; Seligman; Seneca (10 miles S.); Seven Springs, Maricopa Co.; Show Low (14 miles S.); Skull Valley, Yavapai Co.; Snowflake, Navajo Co.; Sonoita; Springerville (25 miles N.); Stanfield (10 miles W.); Stewart Ranch (24 miles N. W. Prescott); Stockton Pass, Pinaleno Mts.; Superior (Boyce Thompson Arbor); Supai, Havaisu Canyon; Toltec; Tombstone; Tucson; Vernon; Warren; Weaver Mts., Yavapai Co.; White Mts.; Whiteriver; Willcox; Williams; Winslow. CALIFORNIA: Naples; Riverside. COLORADO: Antonito; Bellevue; Boulder; Canon City; Colorado Springs; Cotopaxi; Crowley; Denver; Elberta; Florissant; Fort Collins; Fountain; Greeley; Holly; Julesburg; La Junta; Lamar; Las Animas; Mesa Verde; Mischawauka; Nederland; Pagosa Springs; Pingree Park; Portland; Poudre Canyon (near Fort Collins); Prowers; Pueblo; Rock Creek, Routt Co.; Rocky Ford; Salida; Starkville; Steamboat Springs; Sterling; Trinidad; Westcliff. KANSAS: Clark Co.; Coolidge (S. of); Garden City (7 miles E. and 10 miles W.); Greeley Co.; Hamilton Co.; Hugoton (4 miles S. E.); Johnson (2 miles N.); Morton Co.; Rexford; Syracuse (10 miles E.); Wallace Co. LOUISIANA: New Orleans. NEBRASKA: Mitchell. NEVADA: Austin; Baker (Snake Valley), White Pine Co.; Eureka; Tonopah. NEW MEXICO: Acme; Alamogordo; Albuquerque; Albiquie (15 miles N. W.); Artesia; Buckhorn; Carlsbad; Carrizozo; Cedro Canyon, Bernalillo Co.; Cienega Canyon, Sandia Mts.; Clifton House, Colfax Co.; Cloudcroft; Columbus (10 miles N.); Corona; Cuba (32 miles N. W. and 36 miles N.); Cuervo; Datil; Deming; Dripping Spring, Organ Mts.; Eddy Co.; Elda; Embudo; Endee, Quay Co.; Filmore Canyon; Frijolitos Canyon, Sandoval Co.; Gallup; Garfield; Gila River (West Fork); Glenwood; Hatch; Hot Springs; Hurley (5 miles S.); Isleta; Jemez Mts.; Juan Tabo area, Sandia Mts.; La Jara (5 miles E.); Las Cruces; Las Vegas; Lordsburg; Lov-

ing; Luna Co.; Madrid; Magdalena Mts.; Malaga; Maxwell; Mes-calero; Mesilla Park; Montoya; Moriarty; Moses; Mountain Park; Nogal; Pecos; Portales; Quemado; Questa; Radium Springs; Raton; Red Hill (25 miles N. of Quemado); Rodeo; Roswell; Rowe; San Jon; San Jose; San Marciel; Santa Fe; Sapello; Silver City; Springer; State College, Dona Ana Co.; Steins; Tecolote; Tularosa; Vaughn; Whites City; White Sands; Winslow. TEXAS: Abilene; Alfred; Alpine; Amarillo; Austin; Bakersfield; Balmorhea; Bexar Co.; Big Bend National Park; Boragia; Brazos Co.; Brewster Co.; Bronco; Brownsville; Cherry Spring; Chisos Mts., Brewster Co.; Christoval; Comfort; Comstock; Concan (8 miles S.); Cornudas; Cotulla; Crane; Davis Mts.; Dell City (9 miles S.); Del Rio (23 miles S.); Devils River; Eagle Pass; Edinburg; El Paso; Fedor, Lee Co.; Finlay; Fort Davis; Fort Stockton; Harper; Hereford (5 miles S. W.); Hueco; Imperial; Kerrville; Lobo, Culberson Co.; Marathon; Marfa; Mason (10 miles N.); Maverick Co.; Mission (15 miles N. W.); Nueces River, Zavalla Co.; Odessa; Pecos; Pecos River; Presidio Co.; Quemado; Reeves Co.; Rio Grande, Brewster Co.; Sabinal; San Antonio; Sanderson; Santa Elena Canyon, Big Bend National Park; Shumla, Val Verde Co.; Sierra Blanca; Sonora; Stonewall; Toyah; Uvalde; Valentine; Van Horn; Westbrook; White Horse Plateau, Culberson Co.; White Rose Canyon, Jeff Davis Co. UTAH: Beaver; Bluff; Bryce Canyon; Delta; Dove Creek; Erda; Jericho; Iosepa; Jensen (12 miles E.); Juab; Kanab; Kanarraville; Monticello; Moxlena; Oak City; Petersboro; Promontory; Salt Lake City; Santa Clara; Skull Valley; South Cove Fork; Tooele; Vernal. WYOMING: Cheyenne. *México*. AGUASCALIENTES: Aguascalientes; El Retono (10 miles E. of Aguascalientes); Rincon de Romos (12 km. N.). CHIHUAHUA: Agua Caliente, Santa Barbara District; Camargo (20 miles S. W.); Catarinas; Cerro Chilicothe; Charcos, Allende District; Chihuahua; Ciudad Juárez (87 km. S.); Delicias; Jiménez; Matachic; Moctezuma; Ojo Laguna; Parrál; Parrita; Salaíces; Samalayuca; San Jose Babicora; San Pablo Balleza; Santa Barbara; Santa Clara. COAHUILA: Guadalupe; La Rosa; Paila; Saltillo; San Pedro de las Colonias. DURANGO: Durango; El Tascate; Encino; Laguna District; La Loma; Nombre de Dios; Otinapas; Palos Colorados; Pedricena; San Juan del Río; Santa Maria del Oro; Villa Ocampo; Yerbánis, Cuencame District. HIDALGO: Actopán; Ismiquilpan. JALISCO: Encarnacion de Diaz; Lagos de Moreno (15 miles N. E.); Ojuelos; San Juan Lagos. NUEVO LEON: Monterey; Vallecillo. PUEBLA: Puebla (6 miles S. W.); Tehuacán. QUERETARO: San Juan del Río



(5 miles E.). SAN LUIS POTOSÍ: Huizache. TAMAULIPAS: Llera. ZACATECAS: Fresnillo; Guadalupe; Sain Alto; Sombrerete (15 km. E.).

*Flower Records.* *Acacia* sp., *Actinea* sp., *A. acaulis*, *A. richardsonii*, *Allionia incarnata*, *Arabis* sp., *Argemone* sp., *Asclepias* sp., *A. galloides*, *A. verticillata*, *Aster* sp., *A. canescens*, *A. spinosa*, *A. tenacetifolium*, *Astragalus* sp., *Baccharis* sp., *Bahia* sp., *Baileya multiradiata*, *Berberis trifoliata*, *B. wilcoxii*, *Canotia holacantha*, *Ceanothus* sp., *C. fendleri*, *C. greggii*, *Celtis pallida*, *Cercidium* sp., *C. texanum*, *Cevalia sinuata*, *Chilopsis* sp., *C. linearis*, *C. saligua*, *Chrysopsis hispida*, *Chrysanthamnus* sp., *Cirsium* sp., *C. ochrocentrum*, *C. undulatum*, *Cleome* sp., *C. luteum*, *C. serrulata*, *Convolvulus* sp., *Croton* sp., *C. luteovirens*, *Dalea lasianthera*, *Dasyllirion wheeleri*, *Encelia* sp., *Engelmannia pinnatifida*, *Erigeron* sp., *E. canadensis*, *Eriogonum* sp., *E. trichopos*, *Euphorbia albimarginata*, *Eyesenhardtia polystachya*, *E. spinosa*, *Gaillardia* sp., *G. pinnatifida*, *G. pulchella*, *G. suavis*, *Gaura* sp., *Gilia calcarea*, *Gossypium herbaceum*, *Grindelia* sp., *Gutierrezia* sp., *G. californica*, *Haplopappus* sp., *H. gracilis*, *H. laricifolius*, *Helenium autumnalis*, *H. hoopesii*, *H. laciniatum*, *Helianthus* sp., *H. annuus*, *H. ciliaris*, *H. petiolaris*, *Hoffmanseggia densiflora*, *H. jamesii*, *Hymenothrix wislizeni*, *Iris mios*, *Kallstroemia* sp., *K. grandiflora*, *Larrea* sp., *L. divaricata*, *L. tridentata*, *Lepidium* sp., *Lesquerella* sp., *L. ovalifolia*, *Lippia cuneifolia*, *L. ligustrina*, *Lotus* sp., *Lupina* sp., *Lygodesmia juncea*, *Malvastrum cockerelli*, *Marrubium vulgare*, *Medicago sativa*, *Melilotus* sp., *M. alba*, *M. officinalis*, *Mentzelia multiflora*, *Mertenzia franciscana*, *Mimosa borealis*, *Monarda* sp., *M. citriodora*, *M. pectinata*, *Mortonia scabrella*, *Nepeta cataria*, *Nolina* sp., *N. microcarpa*, *Opuntia* sp., *O. basilaris*, *O. lindheimeri*, *O. macrorhiza*, *Parkinsonia* sp., *Pectis papposa*, *Penstemon superba*, *Petalostenum* sp., *P. candidum*, *P. flavescens*, *P. occidentatum*, *Phacelia* sp., *P. glandulosa*, *P. popei*, *Philadelphus microphyllus*, *Polemonium* sp., *Prionopsis* sp., *Prosopis* sp., *P. juliflora*, *Psoralea tenuiflora*, *Pyracantha* sp., *Ratibida* sp., *R. columnaris*, *R. tagetes*, *Rhus* sp., *Rosa* sp., *Salix* sp., *Salsola kali*, *S. pestifer*, *Salvia lemmoni*, *Sapindus drummondii*, *S. sapinarius*, *Senecio longilobus*, *S. werneriaefolius*, *Solanum elaeagnifolium*, *Solidago annua*, *S. stenolobus*, *Sphaeralcea* sp., *S. angustifolia*, *S. coccinea*, *S. emoryi*, *S. laxa*, *S. lobata*, *S. marginata*, *Stephanomeria* sp., *Tamarix* sp., *T. gallica*, *Thurberia thespesioides*, *Verbena stricta*, *Verbesina encelioides*, *Vernonia* sp.,

*Vicia* sp., *Wislizenia refracta*, *Zexmenia podocephala*, *Zinnia grandiflora*.

*Melissodes* (*Eumelissodes*) *boltoniae* Robertson

*Melissodes boltoniae* Robertson, 1905, Trans. Amer. Ent. Soc., vol. 31, p. 368; Cockerell, 1907, Ann. Mag. Nat. Hist., ser. 7, vol. 20, p. 127; 1909, Ann. Mag. Nat. Hist., ser. 8, vol. 4, p. 26; Robertson, 1914, Ent. News, vol. 25, p. 70; 1926, Ecology, vol. 7, p. 379; 1928, Flowers and Insects, p. 8; Pearson, 1933, Ecol. Monogr., vol. 3, p. 380; Brimley, 1938, Insects of North Carolina, p. 462.

*Melissodes melandri* Cockerell, 1906, Trans. Amer. Ent. Soc., vol. 32, p. 109 (new synonymy).

*M. boltoniae* is a small species related to *M. coreopsis*. It can be distinguished from *coreopsis* by the coarsely punctate tergal apices, especially in the female, the often infumate to piceous tergal apices of the male, the often tessellate galeae of both sexes, and the generally darker vestiture of both sexes.

*Female*. Measurements and ratios: N, 20; length, 10-12 mm.; width, 3.5-4.5 mm.; wing length,  $M = 2.89 \pm 0.163$  mm.; hooks in hamulus,  $M = 11.45 \pm 0.145$ ; flagellar segment 1/segment 2,  $M = 1.85 \pm 0.026$ .

Structure and color: Integumental color as in *coreopsis* except as follows: flagellum darker, second segment never pale beneath, segments 3 to 10 dark reddish brown below; wing membranes colorless or slightly infumate; tergum 1 completely piceous or extremely narrowly hyaline apically, rufescent area, if present, less than one-fourth length of tergum.

Structure and sculpturing as in *coreopsis* except as follows: clypeal surface moderately shiny, somewhat dulled by cross-striations; supraclypeal area usually somewhat dulled by fine reticular shagreening; galeae usually dulled by reticular shagreening above at least in apical half; maxillary palpal ratio about 4:3:3:1, rarely with minute fifth segment present, often fourth segment slightly longer; second flagellar segment measured below as long as broad or almost so. Mesoscutum usually with small posteromedial impunctate area. Metasomal tergum 1 with basal half to three-fifths punctate, punctures large, round, deep, often same diameter as median scutellar punctures, separated mostly by one to two puncture widths, apical area impunctate and extended to form impunctate anterolateral lobes; tergum 2 with basal area punctures separated mostly by one to two puncture widths, surface often with fine reticular shagreening, apical area with abundant minute punctures two to three times diameter of hairs arising from them, extending to within one hair length of apical margins and separated mostly by two to four

puncture widths, sparser apically; tergum 3 similar to 2 but interband zone punctures crowded and apical area punctures more abundant, separated mostly by two to three puncture widths; tergum 4 like 2 but apical area absent or reduced to short, very broad, apical triangle with punctures separated mostly by one to two puncture widths.

Hair: As in *coreopsis* except as follows: pale hairs and pubescence white except occasionally pale ochraceous on anterior part of mesoscutum; more variable, some specimens almost entirely black. Palest specimens as in *coreopsis* except dark mesoscutal patch extending forward at least to a transverse line at anterior margins of tegulae, posterior pronotal lobes with at least a few black hairs mixed with the white, tergum 2 with distal pale band interrupted medially, tergum 4 with a few apicomedial, relatively simple, black hairs, sterna black to brown medially and white laterally, scopae white to ochraceous. Darkest specimens completely black except short white distal fasciae on terga 2 and 3, pale scopal hairs, tergum 1 ochraceous basally, and often a few white hairs on face near antennal fossae and on mesoscutum near tegulae. Thoracic hairs above long as in *coreopsis*; tergum 2 with interband zone hairs brown to black, suberect to subappressed, relatively simple, short; terga 2 and 3 with apical area hairs short, reaching or surpassing apical margins medially, black to brown, appressed to subappressed; scopal hairs as in *coreopsis*.

*Male.* Measurements and ratios: N, 20; length, 9-11 mm.; width, 2.5-3.5 mm.; wing length,  $M = 2.74 \pm 0.194$  mm.; hooks in hamulus,  $M = 10.85 \pm 0.196$ ; flagellar segment 2/segment 1,  $M = 8.43 \pm 0.140$ .

Structure and color: Integument black except as follows: clypeus yellow except brown to testaceous apical margin and dark tentorial pits; labrum often with small mediobasal pale spot; apical half of mandible and often distitarsi rufescent; eyes green to bluish green; flagellum below except first segment red and brown above; wing membranes clear to slightly infumate, veins reddish brown to black; tergal apices piceous, occasionally slightly translucent but then smoky brown.

Structure as in *coreopsis* except as follows: minimum length first flagellar segment equals more than one-tenth and usually less than one-eighth maximum length second segment, flagellum in repose reaching slightly beyond pterostigma; galeae usually dulled above at least in apical half; maxillary palpal ratio about 4.5:4.5:3.3:1.3:1.0, fifth segment often absent and then fourth segment slightly



longer. Sculpturing as in female except as follows: posteromedial impunctate mesoscutal area often reduced or absent; tergum 1 punctate in basal five-sixths or more, punctures usually more crowded; tergum 2 with interband zone punctures often larger and sparser; terga 2 and 3 with apical area punctures usually smaller and sparser. Terminalia much as in *M. agilis* (Figs. 84-85).

Hair: Palest specimens as in *coreopsis* except as follows: usually with at least a few brown hairs posteromedially on mesoscutum and medially on scutellum; vertex of head and tegulae often with brown; tergum 1 with simple, appressed to subappressed, long brown to black hairs in apical area usually reaching apical margin medially; tergum 2 with brown in interband zone and apical area; tergum 3 brown except distal pale pubescent band; terga 4 and 5 similar to 3; terga 6 and 7 golden brown to dark brown medially, paler laterally; sterna golden medially to white laterally. Darkest specimens have pale hairs and pubescence dark ochraceous to rust-colored but paler on lower parts of head and thorax; with abundant brown on vertex of head, tegulae, mesoscutum, scutellum; apical third of tergum 1 brown; terga 2 and 4 with distal pale bands interrupted medially, almost wholly brown on tergum 4 and wholly so on tergum 5; sterna brown medially to ochraceous laterally; legs ochraceous except inner hind basitarsi yellow.

*Geographic Variation.* Although the variation in color of vestiture is great in *M. boltoniae*, this variation does not appear to be distributed geographically so as to be able to recognize and name subspecific units. The darkest specimens are abundant in east-central Texas, but also occur in Illinois, Indiana, and Louisiana and pale specimens occur together with the dark even in Texas. Where, as in Texas, a reasonably long series of specimens are available, all intergrades occur between the darkest and the palest individuals.

*Bionomics.* All that can be said about the flower preferences of this bee at this time is that it is an oligolege upon plants of the family Compositae. Out of 40 collections (106 females and 97 males) for which flower data are available, 38 are from some composite and only two are from other families of plants (and these last involve only four males). Of the composites visited by *M. boltoniae* the following genera figure prominently: *Aster*, *Amphiachyris*, *Helianthus*, *Solidago*, and *Bidens*. In the vicinity of Lawrence, Kansas, *boltoniae* can almost invariably be found collecting pollen from flowers of *Amphiachyris dracunculoides*.

*Type Material.* Lectotype female, here designated, of *boltoniae*, collected by Charles A. Robertson, August 31, 1886, at Carlinville, Illinois, on *Coreopsis aristosa*, is in the collection of the Illinois Natural History Survey, Urbana, Illinois. Of the paratypes accompanying this lectotype several are *M. illata* (described below), rather than *M. boltoniae*. The holotype female of *melandri* (a melanistic female) from Fedor, Lee Co., Texas, October 4, 1899, is in the collection of Mr. P. H. Timberlake, Citrus Experiment Station, Riverside, California.

*Distribution.* *M. boltoniae* ranges from Minnesota south to eastern Texas and east to Ohio, North Carolina, and Florida (Fig. 20). It has been collected from July 17 to November 6, but chiefly

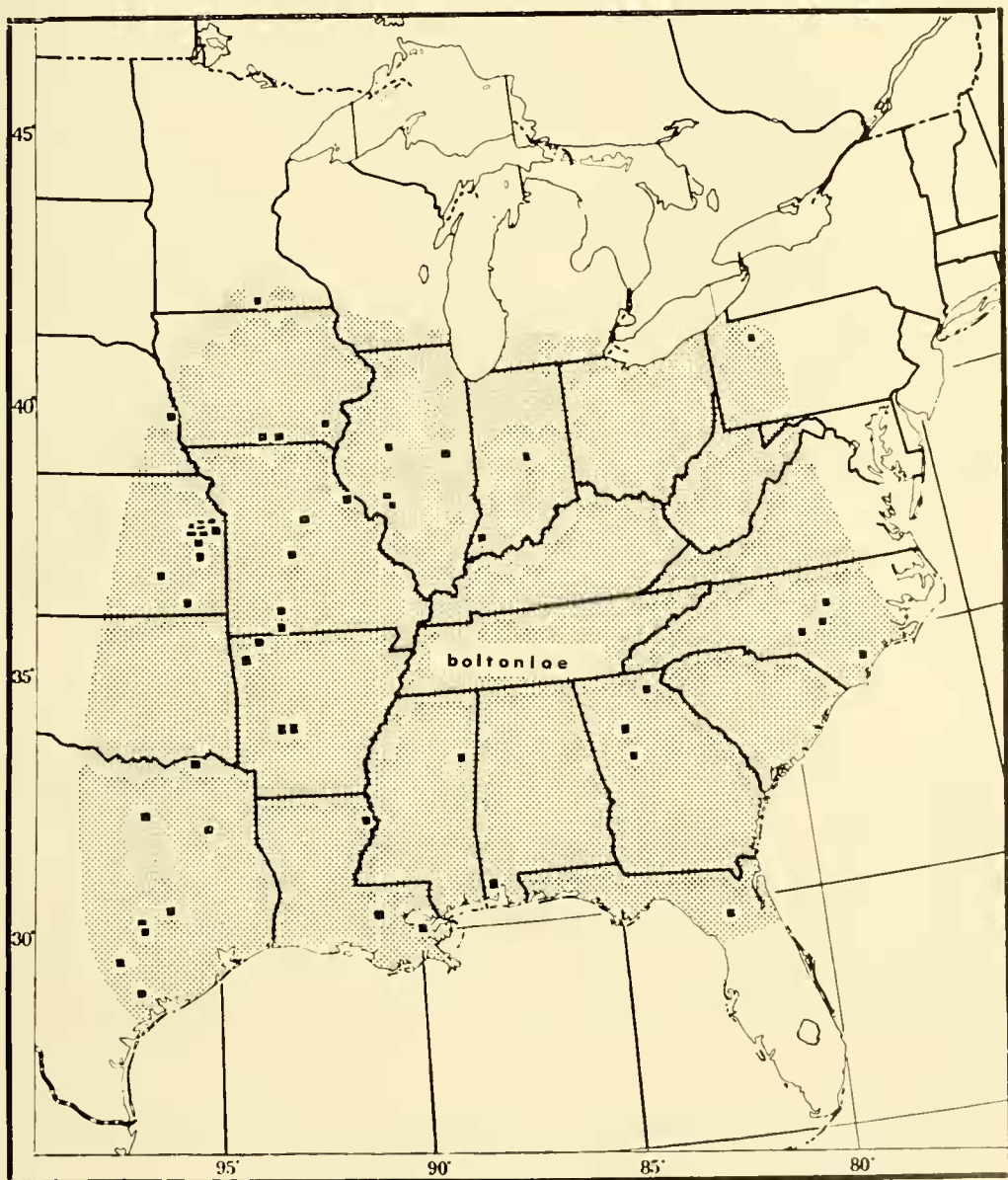


FIG. 20. Map showing the known distribution of *M. (Eumelissodes) boltoniae* Robertson.

in late August and September. In addition to the type material, 162 females and 148 males have been examined from the localities listed below (published records are included only when verified by the author).

ALABAMA: Kushla. ARKANSAS: Eureka Springs; Fayetteville; Hot Springs; Knob Hill Reservation, Ouachita Mts. FLORIDA: Gainesville. GEORGIA: Atlanta; Griffin; Mt. Yonah. ILLINOIS: Carlinville; Macoupin Co.; Manito; Urbana. INDIANA: Oaklondon; Rush Branch. IOWA: Appanoose Co.; Mt. Pleasant (6 miles S. W.); Wayne Co. KANSAS: Baldwin City; De Soto, Johnson Co.; Douglas Co.; Garnett; Independence (3 miles E.); Lawrence; Lone Star Lake, Douglas Co.; Olathe; Ottawa; Reece. LOUISIANA: Baton Rouge; Chalmette National Historical Park, Orleans Co.; Tallulah. MINNESOTA: Freeborn Co. MISSISSIPPI: West Point. MISSOURI: Branson; Columbia; Louisiana; Ozark; Ozark Lake. NEBRASKA: Omaha. NORTH CAROLINA: Burgaw; Harnett Co.; Southern Pines; Wake Co.; Washington Co. PENNSYLVANIA: Lynch, Forest Co. TEXAS: Brazos Co.; Chicota; Dallas, Fedor, Lee Co.; Palmetto State Park, Gonzales Co.; Tyler (3.5 miles N. W.); Victoria.

*Flower Records.* *Abutilon avicennae*, *Amphiachyris* sp., *A. dracunculoides*, *Aster* sp., *A. ericoides villosus*, *A. multiflorus*, *A. novaeangliae*, *A. praeatus*, *Bidens* sp., *B. involucrata*, *Boltonia asteroides*, *Cassia* sp., *Chrysopsis* sp., *Cirsium* sp., *Coreopsis aristosa*, *Helenium altissimum*, *H. autumnale*, *H. tenuifolium*, *Helianthus* sp., *H. annuus*, *H. grosse-serratus*, *H. tuberosus*, *Heterotheca latifolia*, *Lythrum* sp., *Ratibida pinnata*, *Rudbeckia triloba*, *Silphium* sp., *Solidago* sp., *S. canadensis*, *S. missouriensis*, *Verbena* sp., *V. stricta*, *Vernonia* sp., *V. baldwini interior*.

*Melissodes (Eumelissodes) fumosa*, n. sp.

This species is closely allied to *M. boltoniae*. The females of *fumosa* can be readily separated from those of *boltoniae* by the shorter second flagellar segment, the shorter mesoscutal and scutellar hairs, and the less punctate apical area of tergum two. The males of *fumosa* are separated from those of *boltoniae* only with great difficulty and uncertainty. The males of *fumosa* have the apical areas of the terga translucent, yellowish brown to almost colorless, and usually have a slightly shorter first flagellar segment, but *boltoniae* males overlap in both respects to some degree.

*Female.* Measurements and ratios: N, 20; length, 8-10 mm.; width, 3-4 mm.; wing length,  $M = 2.54 \pm 0.084$  mm.; hooks in



hamulus,  $M = 10.95 \pm 0.135$ ; flagellar segment 1/segment 2,  $M = 1.82 \pm 0.032$ .

Structure and color: Integument black except as follows: apical half of mandible and distitarsi rufescent; flagellar segments 3-10 dark red below; eyes gray to slightly green; wing membranes clear or slightly milky, veins dark brown to black; tegulae piceous; tibial spurs white; apex of tergum 1 extremely narrowly hyaline.

Clypeus as in *coreopsis* but surface shiny, with only slight striations, with apicomedian carina distinct; supraclypeal area moderately shiny, usually with fine reticular shagreening; lateral areas of vertex with minute punctures separated by one to three puncture widths, surface shiny; galeae dulled above by fine tessellation at least in apical half; maxillary palpal ratio about 7:5:5:2:1, fifth usually absent; second flagellar segment distinctly shorter than broad, usually length to width about 8:10 or 9:10. Mesosomal sculpturing as in *boltoniae*. Metasomal sculpture as in *boltoniae* except as follows: tergum 1 with basal three-fifths with punctures slightly smaller than scutellar punctures and separated mostly by half to two puncture widths medially; tergum 2 with basal area punctures separated mostly by half to one puncture width, surface unshagreened, interband zone punctures small, separated mostly by half to two puncture widths, apical area largely impunctate but with distinct punctures in basal half medially and almost to apical margin at sides; tergum 3 similar but interband zone and apical area punctures more abundant; terga 2 and 3 with apical areas shiny, shagreening extremely fine. Pygidial plate V-shaped, width subequal to length, apex rounded.

Hair: As in *boltoniae* except as follows: no tendency towards melanism; pale hairs of upper parts of thorax and head bright ochraceous; hairs of mesoscutum and scutellum short; posterior lobes of pronotum without dark hairs; tergum 2 with distal pale band narrowly interrupted medially; tergum 3 with pale band uninterrupted; tergum 4 with pale apical band without apicomedial notch; terga 5 and 6 usually without (holotype) pale lateral tufts; sterna with few or no pale laterally, all reddish brown.

*Male.* Measurements and ratios: N, 20; length, 8-9 mm.; width, 2.5-3.0 mm.; wing length,  $M = 2.52 \pm 0.126$  mm.; hooks in hamulus,  $M = 9.95 \pm 0.170$ ; flagellar segment 2/segment 1,  $M = 8.92 \pm 0.223$ .

Structure and color: Integument black except as follows: clypeus light yellow except testaceous to red apical margin and ten-

torial pits; labrum black; apical half of mandible and distitarsi rufescent; flagellum yellow below, dark above, first segment usually all brown; eyes bluish gray to green; wing membranes colorless, veins reddish brown; tergal apices translucent, infumate, yellow brown to brown, never completely opaque.

Structure as in *boltoniae* except as follows: minimum length first flagellar segment usually equals one-tenth or less maximum length second segment; maxillary palpal ratio about 3.5:3.0:3.0:1.0, minute fifth occasionally present. Sculpturing as in *boltoniae* but tergum 1 with punctures often smaller and terga 2 and 3 with apical areas impunctate. Terminalia as in *agilis* (Figs. 90-91).

Hair: Vestiture as in *boltoniae* except as follows: pale hair of head and thorax often dull ochraceous; mesoscutum and tegulae often without dark hairs; tergum 2 with distal pale band usually narrow and occasionally interrupted medially; tergum 5 with distal pubescent band usually reaching apical margin across entire tergum; terga 6 and 7 with golden brown to dark reddish brown hair.

*Type Material.* Holotype female from Hattiesburg, Mississippi, collected by C. D. Michener, October 10, 1943, on *Chrysopsis microcephala*, and the allotype male from the same locale, collected by C. D. Michener, September 24, 1943, are in the collection of the Snow Entomological Museum of the University of Kansas, Lawrence, Kansas. Eleven female paratypes collected by C. D. Michener at Hattiesburg, Mississippi, are as follows: 2 females with the holotype; 3 females, September 26, 1943; 1 female, October 10, 1943; 1 female, October 17, 1944; 1 female, October 10, 1943, on *Aster dumosus*; 1 female, October 24, 1943, on *A. dumosus*; 2 females, October 1, 1944. One female paratype was collected by C. D. Michener at Camp Shelby near Hattiesburg on October 3, 1944. One male paratype was collected by F. C. Bishopp at West Point, Mississippi, September 16, 1904. The paratypes are in the Snow Entomological Museum, the U. S. National Museum, Washington, D. C., the collection of P. H. Timberlake, Citrus Experiment Station, Riverside, California, the American Museum of Natural History, New York City, and the author's personal collection.

*Distribution.* This species ranges from Maryland west to Nebraska and south to Mississippi and Alabama (Fig. 21). It has been collected from June 8 to October 24, but mainly in August and September. In addition to the type material listed above, 43 females and 56 males have been examined from the localities listed below (the type localities are included).

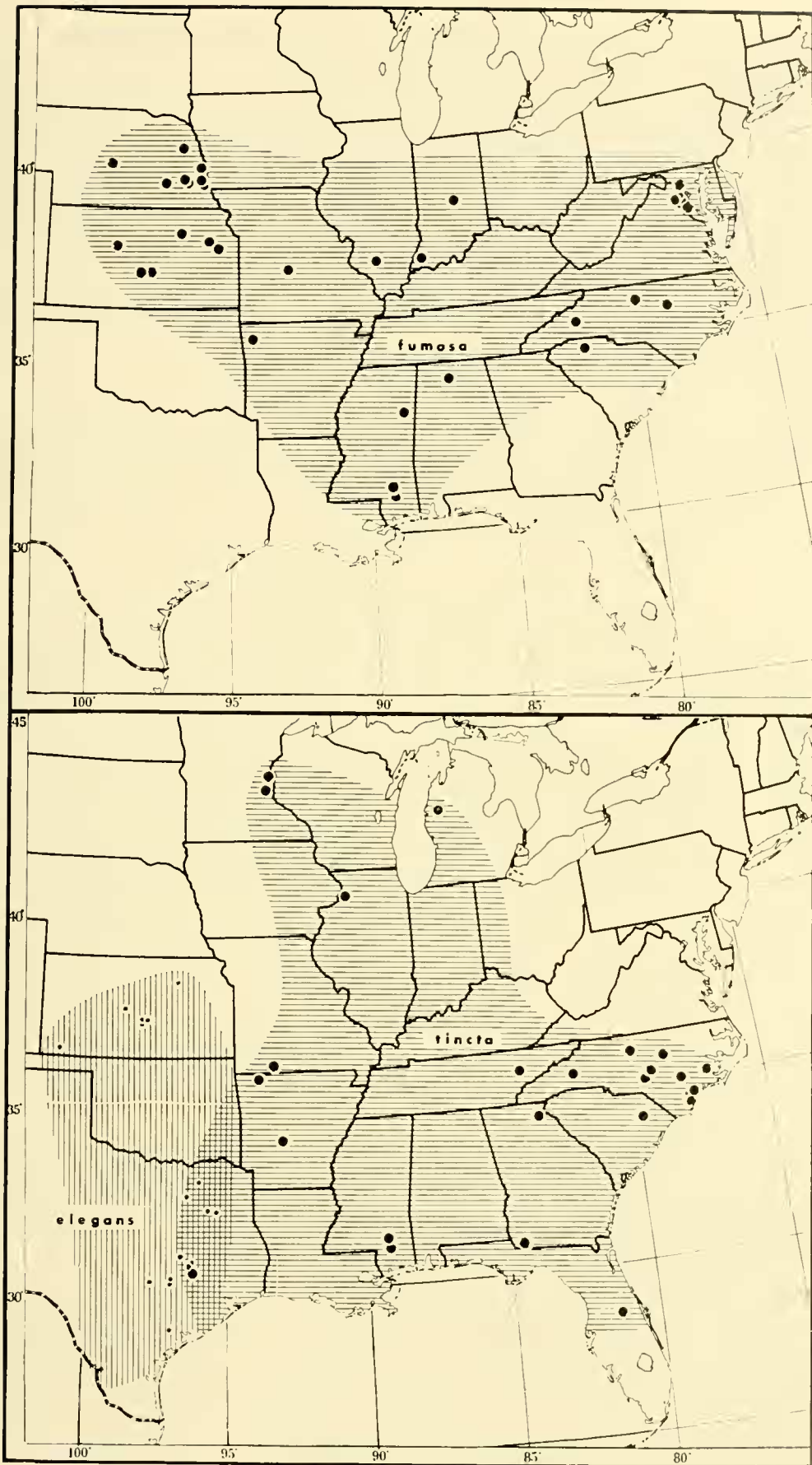


FIG. 21. Map showing the known distributions of *M. (Eumelissodes) fumosa* LaBerge, *M. (E.) elegans* LaBerge, and *M. (E.) tinctoria* LaBerge.



ALABAMA: Decatur. ARKANSAS: Fayetteville. ILLINOIS: Du Bois. INDIANA: Forest Reserve; Oaklandon; Rush Branch. KANSAS: Douglas Co.; Hays; Hutchinson (5 miles N. and 5 miles N. W.); Riley Co.; Topeka. MARYLAND: Cabin John; Indianhead. MISSISSIPPI: Camp Shelby; Hattiesburg; West Point. MISSOURI: Ozark Lake. NEBRASKA: Broken Bow; Lincoln; Louisville; Malcolm; Nebraska City; Omaha; West Point; York Co. NORTH CAROLINA: Greensboro; Marion; Raleigh; Umstead State Park. SOUTH CAROLINA: Spartanburg. VIRGINIA: Alexandria; Falls Church; Mount Vernon; Vienna.

*Flower Records.* *M. fumosa* is an oligolege of composites and seems to prefer flowers of the genus *Solidago*. *Asclepias tuberosus*, *Aster dumosus*, *Boltonia asteroides*, *Chrysopsis microcephala*, *Eupatorium linearifolium*, *Grindelia* sp., *Helenium* sp., *Koellia* sp., *Solidago* sp., *S. canadensis*, *S. glaberima*, *S. rupestris*, *S. serotina*, *Verbena* sp.

*Melissodes (Eumelissodes) elegans*, n. sp.

*Melissodes elegans* is very closely related both to *M. fumosa* and to *M. boltoniae*. The females are like the pale specimens of *boltoniae* in size and color, but can be distinguished by the smaller punctures on tergum 1, the more abundant and deeper punctures of the interband zone of tergum 2, the less punctate apical areas of terga 2 and 3, and the lack of dark hairs on the posterior pronotal lobes. The female can be distinguished from that of *fumosa* by the pale thoracic hairs being white, the coarse interband zone punctures of tergum 2, the less shiny apical areas of terga 2 and 3, and the larger size. The males are much more difficult to identify. They are similar to *fumosa* in the apical tergal areas being translucent, and they have the apical hairs of tergum 1 pale in color, often have pale labral spot, and occasionally have pale spots on the mandibular bases.

*Female.* Measurements and ratios: N, 20; length, 10-12 mm.; width, 3.5-4.5 mm.; wing length,  $M = 2.90 \pm 0.100$  mm.; hooks in hamulus,  $M = 12.15 \pm 0.182$ ; flagellar segment 1/segment 2,  $M = 1.72 \pm 0.023$ .

Structure and color: Integumental color as in *coreopsis* except as follows: second flagellar segment dark below; eyes dark gray (holotype) to bluish gray; wing membranes clear, veins dark reddish brown.

Structure and sculpture as in *coreopsis* with the following excep-

tions or additions: second flagellar segment distinctly longer than broad below (as in *boltoniae*); clypeal surface somewhat dulled by coarse cross-striations; lateral areas of vertex with minute punctures usually separated by two to three puncture widths; galeae dulled above by tessellation at least in apical half; maxillary palpal ratio about 3.5:3.5:3.0:1.0; posteromedial mesoscutal punctures large and sparse but not impunctate as in *boltoniae*; tergum 1 with basal area punctures separated by half to one puncture width and smaller than medial scutellar punctures, surface dulled by dense reticular shagreening; apical area impunctate but not usually with impunctate lobes extending anterolaterally; tergum 2 with basal area punctures round, deep, separated mostly by one puncture width or less, interband zone punctures round, deep, separated mostly by about one puncture width, apical area impunctate; tergum 3 similar to 2 but apical area with abundant minute punctures; pygidial plate with basal width subequal to length.

Hair: Vestiture color and form as in *boltoniae* except as follows: pale hairs white; no tendency towards melanism; posterior pronotal lobes and face without black hairs; mesoscutal dark patch usually extends forward to or beyond a transverse line at anterior margins of tegulae; tergum 1 with apical area with short simple brown hairs basally and extending in anterolateral lobes; tergum 2 with interband zone hairs black, simple, short, appressed to subappressed, with distal pale band usually uninterrupted medially, with apical area hairs abundant, simple, brown, appressed; tergum 4 rarely with short black fringe in median third (not in holotype); tergum 5 with pale lateral tufts, but not usually tergum 6.

*Male.* Measurements and ratios: N, 20; length, 8-11 mm.; width, 2.5-3.5 mm.; wing length,  $M = 2.80 \pm 0.139$  mm.; hooks in hamulus,  $M = 11.00 \pm 0.126$ ; flagellar segment 2/segment 1,  $M = 8.77 \pm 0.284$ .

Structure and color: Integumental color as in *fumosa* except as follows: labrum usually with mediobasal pale spot (allotype); mandibles occasionally with minute pale basal spots (not allotype); tergal apices translucent, infumate (allotype) to almost clear.

Structure and sculpture as in *fumosa* except as follows: minimum length first flagellar segment equals one-tenth or more of maximum length of second segment; maxillary palpal ratio about 7:6:6:2:1 (allotype), fifth often absent; galeae usually tessellate above at least in apical half; tergum 1 with minute punctures in apical area; tergum 2 with basal area and interband zone punctures

usually more abundant and surfaces shiny. Terminalia as in *agilis* but sternum 8 without apical hairs.

Hair: Vestiture as in *coreopsis* except as follows: pale hairs white to ochraceous; vertex without brown; mesoscutum with no (allotype) or few brown hairs; scutellum usually with a few median brown hairs; tergum 1 with apical area hairs short, subappressed, simple, yellow to white, surpassing apical margin; tergum 2 with interband zone hairs long, suberect, white, with apical area hairs subappressed, usually pale brown to black; tergum 3 with apical area hairs pale to dark brown; tergum 5 with distinct apical white band; terga 6 and 7 usually brown, occasionally golden brown.

*Type Material.* Holotype female, allotype male, and four paratype females, collected by L. H. Shinnars, 3.5 miles N. W. of Tyler, Texas, October 12, 1952, on *Heterotheca latifolia* are in the collection of the Snow Entomological Museum of the University of Kansas at Lawrence. Nineteen female and thirteen male paratypes from Brazos Co., Texas, were collected by A. H. Alex as follows: 1 male, September 24, 1954, on *Eupatorium serotinum*; 1 male, September 30, 1954, on *Solidago serotina*; 3 males, October 4, 1954, on *S. serotina*; 1 male, October 5, 1954, on *S. serotina*; 1 female, 2 males, October 6, 1954, on *S. serotina*; 2 males, October 17, 1954, on *Helenium tenuifolium*; 1 female, October 24, 1954, on *Aplopappus divaricatus*; 1 male, October 24, 1954, on *Heterotheca subaxillaris*; 2 females, October 24, 1954, on *H. tenuifolium*; 2 females, October 31, 1954, on *H. subaxillaris*; 2 females, November 5, 1954, on *H. subaxillaris*; 6 females, November 12, 1954, on *H. subaxillaris*; 1 male, September 23, 1955, on *Verbesina encelioides*; 2 females, October 16, 1955, on *H. subaxillaris*. Paratypes are in the collections of Texas A. and M. College, College Station, Texas, the Snow Entomological Museum, the U. S. National Museum, Washington, D. C., and in the author's personal collection.

*Distribution.* This species is known only from Kansas and Texas (Fig. 21). It has been collected from August 26 to November 12, but chiefly in September and October. In addition to the type material, 23 females and 44 males have been studied from the localities listed below (this list includes the type localities).

KANSAS: Great Bend; Hugoton (4 miles S. E.); Hutchinson (3 mile W., 5 miles N., and 5 miles N. W.); Riley Co. TEXAS: Austin; Brazos Co.; Calvert; College Station; Dallas; Fedor, Lee Co.; Laredo; Lee Co.; Tyler (3.5 miles N. W.); Victoria, Wolfe City.



*Flower Records.* *M. elegans* has been collected on flowers other than composites only twice. Flower records are as follows: *Aplopappus divaricatus*, *Aster* sp., *Boltonia asteroides*, *Cleome* sp., *Croton monanthrogynus*, *Fagopyrum* sp., *Grindelia* sp., *Helenium tenuifolium*, *Heterotheca latifolia*, *H. subaxillaris*, *Polygonum* sp., *Prionopsis* sp., *P. ciliata*, *Solidago serotina*, *Verbesina encelioides*.

*Melissodes (Eumelissodes) tincta*, n. sp.

*Melissodes tincta* is a medium-sized bee related closely to *pilleata*, *elegans*, and *coreopsis*. The females of *tincta* are difficult to distinguish from the other species of this complex. They may be told from the females of *pilleata* and *coreopsis* by the finely tessellate or shagreened galeae in which they resemble *boltoniae* and *elegans*. They are larger than the females of *fumosa* and have the second flagellar segment longer. They can be distinguished from *boltoniae* females by the finer punctation of tergum 1 and the apices of terga 2 and 3, and from those of *elegans* by the generally darker color of the vestiture. The males are readily recognized by the usually opaque tergal apices and by the base of the clypeus being infumate with the pale apical yellow portion restricted to one- to two-thirds of the clypeus.

*Female.* Measurements and ratios: N, 20; length, 10-12 mm.; width, 3.5-5.0 mm.; wing length,  $M = 3.16 \pm 0.138$  mm.; hooks in hamulus,  $M = 12.30 \pm 0.193$ ; flagellar segment 1/segment 2,  $M = 1.75 \pm 0.018$ .

Structure and color: Integumental color as in *coreopsis* except as follows: second flagellar segment black, segments 3-10 dark reddish brown to black below; eyes dark gray to gray or green; tergum 1 not rufescent in apical third, with extremely narrow hyaline margin.

Structure and sculpturing as in *coreopsis* except as follows: clypeus slightly protruding to flat, punctures small, separated by half a puncture width, surface dulled by striations or tessellation, apico-median carina present, broad; supraclypeal area punctate, surface usually dulled by coarse shagreening; flattened areas of vertex with small punctures separated mostly by half to one puncture width, surface shiny; maxillary palpal ratio about 2.5:1.6:1.8:1.0; galeae dulled above by fine tessellation at least in apical half; mesoscutum with posteromedian area punctures sparse but not impunctate; tergum 1 with basal area punctures smaller than median scutellar punctures and separated mostly by one to two puncture widths, surface dulled

by fine reticulotransverse shagreening, apical area as in *elegans*; tergum 2 with basal area punctures separated mostly by less than one puncture width, interband zone punctures small, separated by a half to two puncture widths, apical area with minute punctures separated by three to four puncture widths and no more than twice basal width of hairs arising from them, surface as in *elegans*; tergum 3 like 2 but punctures more abundant and apical area punctures larger and more crowded; tergum 4 with apicomedian punctures present when dark apicomedian hairs are present (as in allotype); pygidial plate as in *coreopsis*.

Hair: Vestiture as in *coreopsis* except as follows: dark mesoscutal patch extends forward beyond a transverse line at anterior margins of tegulae; tegulae brown; posterior pronotal lobes usually black (in allotype) mixed with white; ventral parts of episterna usually brown; metasomal tergum 1 with apical area with short, closely appressed, brown hairs at least basad and in lateral lobes; tergum 2 with distal pale band interrupted medially, interband zone with short subappressed, and apical area with short appressed to appressed, dark brown hairs; tergum 3 with distal pale band uninterrupted and not reaching apical margin laterally; tergum 4 with apical fringe of dark hairs in median third (allotype) or more, occasionally black apical hairs absent, occasionally fringe expanded medially to form median triangular dark area; tergum 5 with few (allotype) or no lateral pale hairs; tergum 6 without lateral pale hairs; sterna dark brown, often pale laterally; legs as in *boltoniae*.

*Male.* Measurements and ratios: N, 10; length, 10-11 mm.; width, 3-4 mm.; wing length,  $M = 3.27 \pm 0.158$  mm.; hooks in hamulus,  $M = 11.90 \pm 0.233$ ; flagellar segment 2/segment 1, (5)  $M = 9.19 \pm 0.298$ .

Structure and color: Integument black except as follows: clypeus with apical margin testaceous, with apical transverse band of yellow one- to two-thirds length of clypeus; labrum cream-colored with dark border; apical half of mandible and tarsi rufescent; eyes yellowish gray to green; flagellar segments 3 to 11 red beneath, dark brown above; wing membranes hyaline, veins black to dark reddish brown; metasomal tergal apices piceous and opaque (holotype), rufescent, or rarely only slightly infumate.

Structure as in *coreopsis* except as follows: minimum length first flagellar segment equals one-eighth to one-tenth maximum length second segment, flagellum in repose reaching well beyond pterostigma but not beyond tip of submarginal cell; galeae usually dulled

above at least in apical half; maxillary palpal ratio about 3:2:2:1. Sculpturing as in *boltoniae* but terga 2 and 3 with apical area with sparse punctures. Terminalia as in *agilis* but sternum 8 with few or no hairs.

Hair: Head white with brown on vertex. Mesoscutum, tegulae, and scutellum with abundant reddish brown, thorax white on sides. Metasoma as in *boltoniae*.

*Type Material.* Holotype male from Camp Shelby (near Hattiesburg), Mississippi, collected by C. D. Michener, September 18, 1944, is in the Snow Entomological Museum, the University of Kansas, Lawrence. The allotype female from Hattiesburg, Mississippi, collected by C. D. Michener, October 10, 1943, on *Chrysopsis microcephala*, is in the collection of the American Museum of Natural History, New York City. Three female and six male paratypes collected by C. D. Michener are as follows: Hattiesburg: 1 female, September 24, 1944, on *Chrysopsis microcephala*; 1 male, September 24, 1944. Camp Shelby: 2 females, October 3, 1944; 1 male, October 14, 1944; 1 male, September 13, 1943; 2 males, September 23, 1944; 1 male with the holotype. Paratypes are in the Snow Entomological Museum, the American Museum of Natural History, the collection of P. H. Timberlake, Citrus Experiment Station, Riverside, California, and in the author's collection.

*Distribution.* This species is known from Minnesota and Michigan south to Texas and Florida (Fig. 21). It has been taken from August 6 to December 10, but chiefly in September and October. In addition to the type material, 51 females and 3 males have been examined from the localities listed below (this list includes the type localities).

ARKANSAS: Eureka Springs, Ouachita Mts.; Hot Springs. FLORIDA: Conway; Larkins; South Miami. GEORGIA: Bainbridge; Clarksville. ILLINOIS: Fulton. MICHIGAN: Lake Co.; McCarty Creek, Loon Lake, Lake Co. MINNESOTA: Lake Vadnais, Ramsey Co.; North Branch. MISSISSIPPI: Camp Shelby; Hattiesburg. MISSOURI: Branson. NORTH CAROLINA: Burgaw; Cherry Point; Faison; Holly Shelter; Marion; Raleigh; Southern Pines; Wilmington; Yadkin Co. SOUTH CAROLINA: Florence. TENNESSEE: Knoxville. TEXAS: Ben Wheeler (3.7 miles S. E.); Brazos Co.

*Flower Records.* *M. tinctoria* is an oligolege of composites and seems to prefer the genera *Chrysopsis* and *Aster* in that order. *Aster* sp., *A. longicaulus*, *Chrysopsis* sp., *C. microcephala*, *Helianthus maximilianus*, *Verbesina encelioides*.



*Melissodes (Eumelissodes) pullata* Cresson

*Melissodes pullata* Cresson, 1865, Proc. Ent. Soc. Philadelphia, vol. 4, p. 189; Bray, 1917, Pomona Jour. Ent. Zool., vol. 9, p. 94 (probably misidentification).

*M. pullata* is a small dark Cuban species closely related to *M. boltoniae* of the mainland. The female is distinctive in that the scopal hairs are wholly or largely brown, the galeae are dulled by shagreening and the wings are deeply infumate. The males have piceous tergal apices, infumate wings and the distal pale band of tergum 2 interrupted medially.

*Female.* Measurements and ratios: N, 20; length, 9-10 mm.; width, 3.5-4.0 mm.; wing length,  $M = 3.05 \pm 0.087$  mm.; hooks in hamulus,  $M = 11.85 \pm 0.174$ ; flagellar segment 1/segment 2,  $M = 1.86 \pm 0.051$ .

Structure and color: Integumental color as in *boltoniae* except as follows: flagellum dark brown to black below; eyes greenish gray to dark gray; wing membranes deeply infumate, brown, veins black.

Structure and sculpture as in *boltoniae* except as follows: clypeal surface dulled by coarse reticular shagreening; supraclypeal area moderately dulled by shagreening; galeae dulled above by fine tessellation; maxillary palpal ratio about 3.0:1.8:1.6:1.0; second flagellar segment slightly broader than long. Mesoscutum with posteromedian impunctate area extremely small, if present, usually with punctures in posteromedian area separated by one to two puncture widths, surface shiny, unshagreened or delicately so; mesepisterna with surfaces usually slightly dulled by extremely fine, irregular shagreening. Metasomal tergum 2 with basal area punctures separated mostly by a half puncture width, surface shiny, interband zone punctures regular, separated mostly by one puncture width or slightly more, surface moderately shiny, apical area with minute scattered punctures no larger than twice diameter of hairs arising from them; tergum 3 like 2 but apical area shorter and with fewer punctures, interband zone punctures crowded; tergum 4 like 3 but apical area reduced to small median triangular area; pygidial plate as broad at base as long or broader.

Hair: Head and thorax black. Abdomen black except as follows: distal pubescent band of tergum 2 often partly white, interrupted medially; pubescent bands of terga 2-4 all present but usually dark brown. Legs dark brown except scopal hairs of hind tibiae often dark ochraceous or light brown, especially apically.

*Male.* Measurements and ratios: N, 20; length, 9-11 mm.; width, 2.5-3.5 mm.; wing length,  $M = 3.03 \pm 0.156$  mm.; hooks in hamulus,  $M = 11.40 \pm 0.279$ ; flagellar segment 2/segment 1, (14)  $M = 9.46 \pm 0.153$ .

Structure and color: Integumental color as in *boltoniae* except as follows: labrum without pale post; eyes gray to greenish gray; wing membranes infumate, yellowish brown, veins dark reddish brown to black; tergal apices piceous.

Structure as in *boltoniae* except as follows: maxillary palpal ratio about 3.5:2.2:2.0:1.0; flagellum in repose reaching well beyond pterostigma. Sculpture as in female except as follows: clypeal punctures indistinct; galeae often shiny above and without tessellation except in apical thirds; metasomal tergum 1 punctate to within one-sixth or one-seventh of apical margin but punctures in last fourth of punctate area progressively smaller and sparser; tergum 2 with apical area virtually impunctate; terga 3-5 similar to 2 but apical areas shorter. Terminalia as in *agilis*.

Hair: Head ochraceous usually with brown on vertex. Thorax ochraceous laterally; scutellum dark brown fringed with ochraceous; mesoscutum with dark brown posteromedian patch twice size of scutellar dark patch or larger; ochraceous elsewhere; tegulae with brown. Metasomal tergum 1 ochraceous basally, apical area and anterolateral lobes of apical area with abundant, dark brown, suberect to subappressed, simple hairs; tergum 2 white basally, distal pale band pale ochraceous, interrupted medially, lateral fasciae tapered mesad, interband zone with abundant dark brown, suberect, simple hairs; apical area with subappressed to suberect, dark brown, simple hairs; tergum 3 similar to 2 but basal tomentum brown, apical area subequal in length to distal pale band medially and distal band uninterrupted; tergum 4 like 3 but apical area shorter and distal pale band often brown medially; tergum 5 like 4 but distal pubescent band entirely brown; terga 6 and 7 brown; sterna brown medially to pale ochraceous laterally. Legs ochraceous except orange inner surfaces tarsi and often brown basitibial plates.

*Type Material.* Lectotype female of *pullata* from Cuba is in the collection of the Philadelphia Academy of Sciences (Type No. 2303), Philadelphia, Pennsylvania.

*Distribution.* *M. pullata* is known to occur only in Cuba. It has been collected from September 5 to September 30. In addition to the lectotype, 25 females and 25 males have been examined from the localities listed below.

CUBA: Cabanas, Piñar del Río; Cotorro, Havana; Loma del Gato (Sierra del Cobre), Oriente; Piñar del Río; Playa de Manauas, Havana; Viñales (7 and 24 kilometers N.).

*Melissodes (Eumelissodes) persimilis* Cockerell

*Melissodes persimilis* Cockerell, 1949, Proc. U. S. National Museum, vol. 98, p. 463.

*Melissodes perplexans* Cockerell, 1949, Proc. U. S. National Museum, vol. 98, p. 463 (new synonymy).

*Melissodes griseihirta* Cockerell, 1949, Proc. U. S. National Museum, vol. 98, p. 463 (new synonymy); Michener, 1954, Bull. Amer. Mus. Nat. Hist., vol. 104, p. 132.

*Melissodes aurescens*, Cockerell, 1949, Proc. U. S. National Museum, vol. 98, p. 462 (misidentification—see variety A).

This species is from Central America and is related to our more northern species *montana* and *confusa*. The female differs from that of *montana* by having no brown hair on the tegulae, little or no brown on the mesoscutum, and the distal pale band of tergum 2 being narrowly interrupted medially. The male has no brown hairs on tegulae, mesoscutum, or scutellum, and thus differs from *montana* and *confusa* and also the related *floris* of southern Mexico.

*Female*. Measurements and ratios: N, 3; length, about 12 mm.; width, about 4.5 mm.; wing length,  $M = 3.35 \pm 0.233$  mm.; hooks in hamulus,  $M = 13.00 \pm 0$ ; flagellar segment 1/segment 2,  $M = 1.88 \pm 0.099$ .

Structure and color: Integumental color as in *coreopsis* except as follows: eyes bluish gray; wing membranes colorless to slightly infumate, veins black; tegulae piceous.

Structure and sculpture as in *coreopsis* except as follows: clypeus with well-developed apicomedian carina, surface dulled by coarse reticular shagreening; supraclypeal area shagreened; galeae shiny or slightly shagreened; maxillary palpal ratio about 2.5:1.8:2.0:1.0; mesoscutum with posteromedian impunctate area reduced to two small areas about four puncture widths in width, surface shiny, with fine reticular shagreening especially peripherally; mesepisterna with punctures large and shallow, surface dulled by fine irregular shagreening; metasomal tergum 1 medially with basal half punctate; tergum 2 with interband zone punctures small, indistinct, separated by one to four puncture widths, surface dulled by fine reticular shagreening, apical area impunctate; tergum 3 like 2 but interband zone punctures more crowded and apical area with sparse minute punctures; pygidial plate V-shaped with rounded apex.

Hair: Head pale ochraceous with brown on vertex. Thorax ochraceous laterally, brown on ventral and anterior surfaces mesepi-



sterna; scutellum brown medially, fringed with ochraceous or ferrugineous; mesoscutum ochraceous to dull ferrugineous with small posteromedial area of brown hairs twice scutellar dark area or smaller; tegulae with or without brown. Metasomal vestiture as in *montana* except as follows: tergum 1 with few or no appressed brown in apical area; tergum 2 with interband zone brown hairs subappressed, those of apical area appressed and minute, distal pale band distinctly interrupted medially, lateral fasciae each equal about two-fifths of width of tergum or more; tergum 3 similar to 2 but basal tomentum brown, distal pale band uninterrupted, and apical area shorter; tergum 4 like 3 but distal band apical and often fringed with brown in median third; tergum 5 and often 6 with lateral ochraceous tufts. Legs as in *montana* but inner surfaces hind basitarsi dark brown to black and scopal hairs brown near apex of basitarsi.

*Male.* Measurements and ratios: N, 5; length, 9-12 mm.; width, 3-4 mm.; wing length,  $M = 3.28 \pm 0.419$  mm.; hooks in hamulus,  $M = 11.89 \pm 0.583$ ; flagellar segment 2/segment 1,  $M = 6.81 \pm 0.590$ .

Structure and color: Integumental color as in *montana* except as follows: labrum with small mediobasal pale spot sometimes present; clypeus yellow, occasionally narrowly infuscated posteriorly; eyes gray; wing membranes slightly infumate; tergal apices colorless, narrowly hyaline on tergum 1.

Structure as in *montana* except as follows: minimum length first flagellar segment equals one-fifth or less of maximum length second segment; antennae long; maxillary palpal ratio about 14:9:10:1. Sculpture as in female except as follows: mesoscutum with large shallow punctures almost confluent except in small posteromedial area where separated by two or more puncture widths; mesepisternal punctures large, shallow, separated by less than one puncture width, surface dulled by dense shagreening; tergum 1 with basal four-fifths with punctures coarse, dense; tergum 2 with interband zone punctures separated by one to two puncture widths, surface dulled by dense shagreening; terga 3 and 4 similar but with punctures sparser. Sternum 7 and 8 as in *agilis*, median plates of sternum 7 with apical margins converging basomedially, apicoventral tubercle of sternum 8 sharply pointed. Genitalia as in *agilis* (see Michener, 1954, p. 133, figs. 104-106); but sternum 7 with median plates with ventral hairs minute, seemingly glabrous and sternum 8 with ventral tubercle acute.

Hair: Head and thorax ochraceous to dull ferrugineous on dorsum

of thorax except as follows: vertex often with brown; scutellum usually with brown medially; mesoscutum usually with brown posteromedially; tegulae usually without brown. Metasomal vestiture as in *montana* except as follows: terga 2 to 5 with pale distal bands narrow but complete; terga 6 and 7 dark brown. Legs as in *montana*.

*Type Material.* The holotype female of *persimilis*, collected at Agua Amarillo (= Agua Maria), Honduras, November 17 by Viales, is in the U. S. National Museum (Type No. 58542), Washington, D. C. The holotype female of *perplexans*, collected at Uyaca Peak, February 9, by W. P. Cockerell, is in the U. S. National Museum (Type No. 58543). The holotype male of *griseihirta* from Uyaca Peak, Honduras, collected by Morales on March 9, is in the U. S. National Museum (Type No. 58544).

*Distribution.* *M. persimilis* is known from Guatemala, Honduras and Panamá. In addition to the type material, 3 females and 5 males were examined by the author. Michener (1954) records males from Panamá. These records are listed below.

GUATEMALA: Cunen, August 11, 1947, C. and P. Vaurie; Tecpán, October 9, 1929, D. M. Bates. HONDURAS: Aguas Amarilla, 1 female on November 17; 1 female on December 18. PANAMA: Bambito, Volcan Chiriquí, December, 1946, Krauss; El Volcan Chiriquí, February 25, 26, and 29, 1936, Gertsch and Lutz.

### *Melissodes (Eumelissodes) manipularis* Smith

*Melissodes manipularis* Smith, 1854, Cat. Hymen. British Museum, part 2, p. 240; Cockerell, 1905, Trans. Amer. Ent. Soc., vol. 31, p. 329; 1907, Ann. Mag. Nat. Hist., ser. 7, vol. 20, p. 127.

*M. manipularis* is a distinctive bee related to *coreopsis* but not as closely as are other members of the *coreopsis-boltoniae* complex of species. The female of *manipularis* is distinctive in the ochraceous to almost red color of the pale head and thorax hairs, the small size of the mesoscutal dark hair patch, the lack of pale lateral tufts on terga 5 and 6, and the dulled galeae. The male is distinctive in the length of the antennae and of the first and second flagellar segments as described below, and in the shape of the basitibial plates as described below.

*Female.* Measurements and ratios: N, 7; length, 12-13 mm.; width, about 4.5 mm.; wing length,  $M = 3.63 \pm 0.061$  mm.; hooks in hamulus,  $M = 12.29 \pm 0.286$ ; flagellar segment 1/segment 2,  $M = 1.82 \pm 0.032$ .

Structure and color: Integument black except as follows: apical half of mandible and distitarsi rufescent; flagellum red below, segments 2 to 4 darker basad, segment 2 often wholly brown; eyes gray to green; wing membranes clear, veins reddish brown; first tergum extremely narrowly hyaline at apex; tegulae piceous; tibial spurs yellow.

Structure and sculpturing as in *coreopsis* except as follows: clypeus and supraclypeal area shiny, shagreening sparse and extremely fine if present; galeae dulled above by fine tessellation; second flagellar segment subequal in length to apical width; maxillary palpal ratio about 5.7:4.3:3.7:1.0; posteromedian mesoscutal punctures separated by one to two puncture widths, not markedly impunctate posteromedially, surface unshagreened; mesepisternal punctures smaller than posteromedian mesoscutal punctures, surface shiny; tergum 1 with basal three-fifths with punctures small, separated mostly by one puncture width or less, surface reticulotransversely shagreened, apical area with anterolateral lobes not impunctate but more sparsely so; tergum 2 with interband zone punctures same size as small basal area punctures and separated mostly by two puncture widths or more, surface dulled as in tergum 1, apical area with sparse punctures no wider than twice width of hairs arising from them, surface finely shagreened, shiny; tergum 3 similar to 2 but interband zone punctures more abundant and apical area punctures separated mostly by one to two puncture widths; pygidial plate V-shaped, basal width subequal to length, apex rounded.

Hair: Head ochraceous below to bright ochraceous or reddish near vertex, vertex dark brown. Thorax ochraceous laterally and posteriorly; pale mesoscutal and scutellar hairs bright ochraceous to fox red; mesoscutal dark brown patch equals scutellar in size and not extending forward to a transverse line at anterior margins of tegulae. Tergum 1 with basal area ochraceous, apical area with short, simple, closely appressed, dark brown hairs at least basally and in anterolateral lobes; tergum 2 white basally, distal pubescent band white, narrowly interrupted medially if at all, connected with basal white band at extreme sides, interband zone hairs suberect to subappressed, simple, dark brown, apical area hairs subappressed to appressed, simple, dark brown; tergum 3 similar to 2 but basal tomentum dark brown, distal white band uninterrupted; tergum 4 with apical white pubescent band with dark brown fringe in median third to one-half and often with some brown pubescence medially; terga 5 and 6 without pale lateral tufts; sterna dark brown. Legs



ochraceous except as follows: scopae often yellow; basitibial plates, outer-apical surfaces of tibiae, outer surface fore tarsi dark brown; outer surface middle and hind tarsi brown; inner surface hind basitarsi reddish brown; inner surface hind tibiae red to yellow.

*Male.* Measurements and ratios: N, 5; length, about 13 mm.; width, about 4 mm.; wing length,  $M = 3.71 \pm 0.314$  mm.; hooks in hamulus,  $M = 12.20 \pm 0.374$ ; flagellar segment 2/segment 1,  $M = 10.07 \pm 0.243$ .

Structure and color: Integument black except as follows: clypeus yellow except brown at tentorial pits and apical margin, occasionally infuscated between tentorial pits; labrum entirely black or with large mediobasal pale spot; mandibles without basal yellow maculae or these extremely small; distitarsi and apical half mandibles rufescent; flagellum yellow to red below (including first segment), dark brown above; eyes gray to green; wing membranes clear to slightly milky, veins dark red to reddish brown; tergal apices infumate, piceous, first tergum usually narrowly translucent yellow, occasionally clear, apically; tegulae piceous; tibial spurs yellow.

Structure and sculpturing as in *coreopsis* with the following exceptions and additions: minimum length first flagellar segment equals one-tenth or less maximum length second segment; maxillary palpal ratio about 6.0:5.3:3.3:1.0; tergum 1 with minute punctures in apical area to within one hair length of apex; tergum 2-4 with apical areas punctate as in female but punctures usually smaller and sparser; basitibial plate short, with relatively straight apical edge and distinct apicoposterior angle. Terminalia as in *agilis*.

Hair: Head ochraceous. Thorax ochraceous laterally, bright ochraceous to dull yellow dorsally with larger scutellar and mesoscutal dark brown patches, mesoscutal dark patch subequal to scutellar. Metasomal tergum 1 ochraceous basally, with short, subappressed, simple, dark brown hairs apically; tergum 2 white basally, distal pubescent band white, often narrowly interrupted medially and connected to basal band at extreme sides, interband and apical areas with abundant suberect to subappressed, dark brown, simple hairs; tergum 3 similar to 2 but basal tomentum brown and distal white band reaches apex at least laterally; tergum 5 without white pubescence or this restricted to short apicolateral fasciae; terga 6 and 7 dark brown; sterna dark brown. Legs ochraceous except inner surfaces tarsi red to yellowish red.

*Type Material.* Holotype male from Georgia is in the British Museum (Natural History) (Type No. 17-B-1157), London, Eng-

land. The holotype has the labrum with pale mediobasal spot equaling about one-third of surface area and has extremely minute pale basal mandibular spots.

*Distribution.* *M. manipularis* is known from Florida to North Carolina (Fig. 11). In addition to the holotype, seven females and five males were examined. The data for these is listed below. Cockrell (1907) records this species on *Eupatorium* at Falls Church, Virginia, but this record has not been verified by the author.

FLORIDA: Alachua Co.: 1 male, September 1, 1955, F. L. Wilson; "Fla", Dept. Agriculture, 2 males. GEORGIA: the holotype male. NORTH CAROLINA: Southern Pines: 2 females, September 15, 1949, T. B. Mitchell; 2 females, September 15, 1949, on *Chrysopsis* sp., T. B. Mitchell; 1 male, September 10, 1950, T. B. Mitchell; 1 female, September 19, 1953, on *Petalostemum* sp., T. B. Mitchell. WILMINGTON: 1 female, September 19, 1954, T. B. Mitchell. SOUTH CAROLINA: Aiken: 1 male, September 7, 1951, on *Petalostemum* sp., T. B. Mitchell.

*Melissodes (Eumelissodes) comata*, n. sp.

This large Mexican species, known only from males from Baja California, is closely related to *M. confusa* and to *M. montana*. It has the sparsely punctate basal area of tergum 2 and the short first flagellar segments as in *confusa*. On the other hand, it has the darker clypeus and vestiture and the more protuberant clypeus of *montana*. The clypeus of *comata* is entirely black or almost so and the surfaces of the clypeus and supraclypeal area are strongly shagreened. The galeae are only lightly shagreened or not at all.

*Male.* Measurements and ratios: N, 7; length, 11-12 mm.; width 3.5-4.0 mm.; wing length,  $M = 3.54 \pm 0.154$  mm.; hooks in hamulus,  $M = 12.57 \pm 0.369$ ; flagellar segment 2/segment 1,  $M = 8.56 \pm 0.124$ .

Structure and color: Integumental color as in *confusa* except as follows: clypeus entirely black or with a small, subapical, bilobed yellow macula less than one-sixth area of clypeus (in two specimens); eyes dark gray; flagellar segments 3-11 red below, segment 2 dark brown near base shaded to red apically; tergal apices hyaline, colorless apically to yellowish brown basally.

Structure as in *montana* except as follows: minimum length first flagellar segment equals about one-tenth maximum length second segment; maxillary palpal ratio about 2.6:2.0:2.4:1.0. Clypeus with large shallow punctures without distinct anterior margins, separated by half to one puncture width posteromedially and by less

elsewhere, with distinct subapical median carina or boss, surface dulled by coarse reticular shagreening; supraclypeal area impunctate medially, dulled by coarse reticular shagreening; galeae above shiny, shagreening, if present, fine and sparse; lateral areas vertex with minute punctures separated by three to four puncture widths, surface shiny. Mesoscutum with posteromedian area impunctate or with scattered punctures, anteriorly large punctures separated mostly by half to one and one-half puncture widths, surface shiny; scutellum similar to anterior third of mesoscutum; mesepisterna with deep punctures separated mostly by half a puncture width, surface shiny but fine irregular shagreening may be present. Metasomal tergum 1 with basal four-fifths or slightly more with large shallow punctures separated mostly by half to one puncture widths, smaller and sparser near impunctate apical area, surface somewhat dulled by reticulotransverse shagreening; tergum 2 with basal area punctures separated mostly by one to two puncture widths, surface reticularly shagreened, interband zone punctures small, separated mostly by two to three puncture widths or more, surface moderately dulled by reticulotransverse shagreening, apical area impunctate, moderately dull, finely shagreened; terga 3-5 similar to 2 except interband zone more densely and reticularly shagreened and apical areas progressively shorter. Terminalia as in *agilis* but sternum 8 with ventral tubercle acute and sternum 7 with median plates with sparse, minute, ventral hairs.

Hair: Vestiture of long hair. Head white except abundant dark brown on vertex. Thorax white except as follows: scutellum dark brown fringed with white; mesoscutum with posteromedian dark brown patch at least twice as large as scutellar dark area and extending forwards to a transverse line at anterior margins of tegulae; tegulae with dark brown. Metasomal tergum 1 with long white basal hairs, apical area with short, simple, suberect, dark brown hairs; tergum 2 with basal area white, distal pale band white, shorter medially than apical area, interband zone with suberect to erect, brown hairs, apical area with simple, brown, suberect hairs (almost completely worn away in specimens before me); terga 3-5 similar to 2 but basal tomentum dark brown, distal pale bands progressively longer and closer to apex until on tergum 5 it reaches apex across most of tergum (distal band brown medially on tergum 5); terga 6 and 7 brown medially to white laterally; sterna yellow medially to white laterally. Legs white except inner surfaces tarsi yellow.

*Type Material.* The holotype male and six male paratypes were collected by Ross and Bohart, October 14, 1941, at La Laguna, Sierra



Laguna, Baja California, México. The holotype is in the collection of the California Academy of Sciences, San Francisco. Paratypes are in the collections of the California Academy of Sciences, the Snow Entomological Museum of the University of Kansas, Lawrence, and in the author's collection.

*Melissodes (Eumelissodes) expolita*, n. sp.

This is a medium-sized bee from the southwest which is similar to *M. coreopsis* but distinctive in both sexes because of the extremely small and scattered punctures on both thorax and abdomen. It does not seem to be closely related to any one group of species, but more closely resembles *coreopsis* than any other species. *M. expolita* also resembles certain species of the *subagilis* group, especially in punctuation.

*Female.* Measurements and ratios: N, 7; length, about 12 mm.; width about 4 mm.; wing length,  $M = 3.23 \pm 0.121$  mm.; hooks in hamulus,  $M = 13.00 \pm 0.218$ ; flagellar segment 1/segment 2,  $M = 1.82 \pm 0.043$ .

Structure and color: Integumental color as in *coreopsis* except eyes gray to greenish blue. Structure and sculpture as in *coreopsis* except as follows: clypeal surface unshagreened; supraclypeal area impunctate or with two or three small punctures, surface shiny; vertex with lateral areas with small round punctures separated by three or four puncture widths or more, surface shiny; maxillary palpal ratio about 2.7:2.3:2.3:1.0; mesoscutal punctures minute, posteromedian area impunctate or with one to four scattered punctures, anteriorly at level of anterior end of parapsidal line punctures separated mostly by two or more puncture widths, surface shiny, unshagreened; scutellar punctures small, medially separated by one to three puncture widths; mesepisternal punctures separated by half to one puncture width, surface shiny; propodeum with dorsal surface irregularly rugose basally, punctate apically, posterior surface sparsely punctate with upper triangular area impunctate, lateral surfaces densely punctate, surfaces shiny, with fine reticular shagreening; metasomal tergum 1 with basal half medially with round shallow punctures separated mostly by one to two puncture widths, surface dulled by coarse reticulotransverse shagreening, apical area and anterolateral lobes impunctate, somewhat dulled by fine reticulotransverse shagreening; tergum 2 with basal area punctures separated mostly by one puncture width, surface reticularly shagreened, interband zone punctures minute, mostly smaller than in basal area,

separated by two to three puncture widths or more, surface as in apical area of tergum 1, apical area impunctate or with minute sparse punctures less than twice diameter of hairs arising from them, surface somewhat shinier than interband zone; tergum 3 similar to 2 but interband zone punctures more abundant and apical area shorter; tergum 4 similar to 3 but apical area absent; pygidial plate somewhat U-shaped with rounded apex and broadening basally.

Hair: Head white to pale ochraceous above. Thorax white laterally, white to pale ochraceous above. Metasomal vestiture as in *coreopsis* except as follows: pubescence generally white; tergum 2 with distal white band as long medially as interband zone and as long as or longer than apical area, uninterrupted; tergum 3 with distal white band reaching apical margin at extreme sides; tergum 4 with white apical band uninterrupted; terga 5 and 6 pale (holotype) to dark brown, white laterally. Legs white except as follows: fore tarsi brown; basitibial plates orange to pale brown; inner surfaces hind basitarsi yellow to yellowish red.

*Male.* Measurements and ratios: N, 10; length, about 11 mm.; width about 3.5 mm.; wing length,  $M = 3.24 \pm 0.192$  mm.; hooks in hamulus,  $M = 12.70 \pm 0.423$ ; flagellar segment 2/segment 1, (9)  $M = 6.29 \pm 0.200$ .

Structure and color: Integumental color as in *coreopsis* except as follows: first flagellar segment wholly dark brown; wing veins dark brown to black; tegulae piceous; tergal apices hyaline, colorless to slightly smoky, not reddened basally.

Structure as in *coreopsis* except as follows: minimum length first flagellar segment equals more than half its own maximum length and about one-sixth maximum length second segment; maxillary palpal ratio about 2.7:2.7:2.5:1.0. Sculpture as in female except as follows: clypeal punctures shallow, indistinct; mesoscutum with posteromedian area often with scattered minute punctures, anterior sixth often as impunctate as posteromedian area or more so; tergum 1 with basal five-sixths punctate; terga 3-5 similar to 2 but with interband zones more punctate and apical areas progressively shorter to absent in fifth. Terminalia as in *agilis* except as follows: spatha  $\frac{1}{3}$  as long as broad or slightly longer; gonostyli heavy, with hairs near base short, acute, stout; sternum 7 with lateral plate narrow in apical third, at about one-third from apex equals in width less than one-third length of plate; sternum 8 with ventral tubercle acute.

Hair: Head and thorax white. Metasomal vestiture as in *coreop-*

sis except as follows: generally white; tergum 2 with distal white band uninterrupted medially (unless worn), shorter than or subequal to apical area medially; sterna white. Legs white except inner surfaces hind basitarsi yellow.

*Type Material.* The holotype female, allotype male, and four female and one male paratypes from 10 miles N. of Tucson, Arizona, were collected on *Encelia farinosa*, April 24, 1955, by G. D. Butler. Seven male paratypes from Arizona are as follows: Tucson: 1 male, May 20, 1935, Bryant; 2 males, April 23, 1953, A. and H. Dietrich. Santa Catalina Mts.: 1 male on *Baileya* sp., April 17, 1955, G. D. Butler; 1 male, May 3, 1937, Bryant. Wickenburg: 2 males, April 30, 1938, J. A. Comstock. In addition, 2 female and 1 male paratypes are as follows: Imperial, California: 1 male, May 1911, J. C. Bridwell. Imuris (12 miles N.), Sonora, México: 1 female on *Chrysothamus* sp., May 11, 1953, R. C. Bechtel and E. I. Schlinger. Santa Ana (8 miles S.), Sonora, México: 1 female, May 11, 1953, R. C. Bechtel and E. I. Schlinger (see Fig. 14 for distribution). The holotype and allotype are the property of the University of Arizona, Tucson, but are deposited on indefinite loan in the Snow Entomological Museum of the University of Kansas, Lawrence. Paratypes are in the collections of the University of Arizona, the Los Angeles County Museum, Los Angeles, California, the California Academy of Sciences, San Francisco, the U. S. National Museum, Washington, D. C., Cornell University, Ithaca, New York, the University of California at Berkeley and in the author's collection.

*Melissodes (Eumelissodes) interrupta*, n. sp.

This species from Central Mexico is closely related to *persimilis* of Central America. The female of *interrupta* can be distinguished from that of *persimilis* (and from its relatives *montana* and *confusa*) by the broadly interrupted distal pale band of the second tergum and by the pale hairs of the inner surfaces of the hind basitarsi. The male of *interrupta* is less readily identified. It also has the interrupted distal pale band of tergum 2 but this is more narrowly interrupted. The male has extraordinarily long hairs on the head, thorax, and hind legs. In this way it resembles *rufipes* and *comata* (both from Mexico) but differs from the latter in the color of the abdominal vestiture and of the clypeus, respectively.

*Female.* Measurements and ratios: N, 12; length, 10-14 mm.; width, 3.5-5.0 mm.; wing length,  $M = 3.58 \pm 0.467$  mm.; hooks in hamulus,  $M = 13.00 \pm 0.408$ ; flagellar segment 1/segment 2,  $M = 1.79 \pm 0.014$ .



Structure and color: Integumental color as in *coreopsis* except as follows: flagellar segment 2 black, segments 3 to 10 black below or very slightly reddened (in holotype last three segments slightly reddened); eyes brownish gray; wing veins dark reddish brown; tegulae testaceous.

Structure and sculpture as in *coreopsis* except as follows: clypeal punctures large (larger than mesoscutal punctures), crowded, apicomedian carina short (holotype) or absent, surface shiny, coarse sparse shagreening may be present peripherally; maxillary palpal ratio about 3.4:2.4:2.4:1.0; vertex with lateral area punctures large, separated mostly by one-half to one or slightly more puncture widths, surface shiny; metasomal tergum 1 punctate in basal half to three-fifths, punctures shallow, indistinct, surface reticularly shagreened, apical area impunctate, with anterolateral impunctate lobes; tergum 2 with interband zone punctures minute, separated mostly by two puncture widths or more laterally, by four or five puncture widths medially, apical area impunctate except minute sparse punctures between mesal ends of lateral fasciae; tergum 3 similar to 2 but interband zone punctures more abundant; pygidial plate with rounded apex.

Hair: Head and thorax ochraceous except as follows: vertex with abundant brown, mesepisterna with ventral and anterior surfaces brown, scutellum brown medially, mesoscutum brown posteromedially, and tegulae with brown; mesoscutal dark area about twice size of scutellar; dorsum of thorax with pale hairs yellowish. Metasomal vestiture as in *coreopsis* except as follows: tergum 1 with anterolateral lobes of apical area with sparse, simple brown hairs; tergum 2 with interband zone brown hairs subappressed, apical area brown hairs short and appressed, distal pale band interrupted medially by a gap almost equal to width of lateral fasciae thus resulting fasciae truncate or rounded medially; tergum 3 like 2 but distal pale band uninterrupted, basal tomentum brown, apical area short; terga 6 and 7 with lateral pale tufts (often absent on 7). Legs as in *coreopsis* except inner surfaces hind basitarsi yellow to red.

*Male.* Measurements and ratios: N, 5; length, 11-14 mm.; width, 3.5-4.5 mm.; wing length,  $M = 3.76 \pm 0.322$ ; hooks in hamulus,  $M = 13.00 \pm 0.447$ ; flagellar segment 2/segment 1,  $M = 7.87 \pm 0.128$ .

Structure and color: Integumental color as in *coreopsis* except as follows: clypeal apical margin dark brown; labrum without pale spot; first flagellar segment brown, segments 2 to 11 yellow to red

below; terga without rufescent area basad of apical hyaline area.

Structure as in *coreopsis* except as follows: minimum length first flagellar segment about one-eighth maximum length second segment, flagellum in repose surpassing pterostigma; maxillary palpal ratio about 3.0:2.6:2.6:1.0. Sculpturing as in female except as follows: clypeal punctures indistinct; tergum 1 with basal four-fifths or more punctate; tergum 2 with interband zone punctures separated mostly by two to three puncture widths; terga 3 to 5 similar to 2 but interband zone punctures slightly more crowded. Terminalia as in *agilis* but sternum 7 with median plate shorter, shorter than lateral plate.

Hair: Hair long, on vertex of head, anterior third of mesoscutum, mesepisterna, and outer-posterior surface of hind basitarsi many hairs longer than third flagellar segment. Head white to pale ochraceous. Thorax white to pale ochraceous laterally, pale ochraceous above, occasionally with brown on scutellum medially (allotype) and a few brown on mesoscutum; tegulae pale. Metasomal vestiture as in *montana* except as follows: tergum 1 with apical hairs pale ochraceous to white; tergum 2 with interband zone hairs erect, white, apical area hairs long, subappressed, brown, distal pale band usually narrowly interrupted medially; terga 3-4 similar to 2 but distal bands uninterrupted; tergum 5 usually with distal pale band interrupted medially (narrowly in allotype) to absent; terga 6 and 7 brown with pale lateral hairs; sterna yellow medially to white laterally. Legs white or pale ochraceous except inner surfaces tarsi yellow.

*Type Material.* The holotype female, allotype male, and six female and two male paratypes from Palos Colorados, Durango, México, were collected on August 5, 1947, by C. D. Michener. In addition, three female and two male paratypes from México are as follows: DURANGO: Palos Colorados: 1 female and 2 males, August 5, 1947, M. A. Cazier; 1 female, August 10, 1947, W. Gertsch. MICHOACAN: 1 female, July 17, 1953, University of Kansas Mexican Expedition. Two additional females collected by Michener at Palos Colorados, Durango, on August 5, 1947, are assigned to this species, but excluded from the type series because of their excessively small size. The holotype and allotype are in the collection of the American Museum of Natural History, New York City. The paratypes are in the American Museum, the Snow Entomological Museum of the University of Kansas, Lawrence, and in the author's collection.

*Melissodes (Eumelissodes) floris* Cockerell

*Melissodes floris* Cockerell, 1896, Ann. Mag. Nat. Hist., ser. 6, vol. 18, p. 290; 1899, Cat. de las Abejas de México, p. 13.

This species from Mexico and Guatemala is known only in the male sex. It resembles closely the males of such species as *confusa* and *montana* from the north, and *persimilis* from Central America. It can be distinguished from *interrupta* by its darker vestiture, from *persimilis* by the longer distal pale band of terga 2 and 3, from *confusa* and *montana* by slight differences in sculpture. It may be nothing more than a local variant of one of the above named species, but nothing should be decided until more specimens are available for study.

*Male.* Measurements and ratios: N, 1; length, about 10 mm.; width, about 3 mm.; wing length, 2.92 mm.; hooks in hamulus, 12; flagellar segment 2/segment 1, 6.29.

Structure and color: Integumental color as in *coreopsis* except as follows: mandibular bases and labrum black; clypeus with apical margin brown and narrowly infuscated along posterior border (also in holotype); eyes gray; flagellar segments 3 to 10 yellow beneath; wing membranes slightly milky, veins dark brown to black; terga 2 to 5 with apical areas hyaline, not reddened basad of apical areas.

Structure and sculpture as in *coreopsis* except as follows: minimum length first flagellar segment one-fifth (holotype) to one sixth or slightly less maximum length second segment, flagellum in repose reaching pterostigma; maxillary palpal ratio about 12:8:10:5:1; galeae unshagreened above, shiny; supraclypeal area reticularly shagreened; mesoscutal punctures peripherally separated by half to one puncture width, posteromedially by two to three puncture widths, surface shiny or slightly dulled by fine reticular shagreening; metasomal tergum 1 with punctures in basal four-fifths, mediobasally punctures separated by half to two puncture widths and surface dulled by dense coarse reticular shagreening, apically less punctate to impunctate in apical fifth and surface shinier, with reticulotransverse shagreening; tergum 2 with basal area punctures separated mostly by one puncture width, surface reticularly shagreened, interband zone punctures separated mostly by one to two puncture widths, surface dulled by fine reticular shagreening, apical area impunctate; terga 3 to 5 similar to 2; sternum 6 with subapical oblique carinae absent or weak. Termi-



nalía as in *agilis* but sternum 8 with ventral tubercle acute and gonostyli not much capitate.

Hair: Head pale ochraceous with sparse brown on vertex. Thorax pale ochraceous laterally; darker ochraceous to almost ferrugineous above with large posteromedian brown area on mesoscutum and scutellum with large median brown area subequal in size to mesoscutal dark area; tegulae with dark brown. Metasomal vestiture as in *confusa* except as follows: tergum 2 with distal pale band not strongly arched or markedly thinned medially, subequal in length to apical area, interband and apical areas with hairs suberect, dark brown; terga 3-5 similar to 2 but apical areas progressively shorter; terga 6 and 7 brown medially to ochraceous laterally; sterna yellow medially to ochraceous laterally. Legs pale ochraceous except inner surfaces tarsi yellow.

*Type Material.* The holotype male of *floris* from San Rafael, Veracruz, México, C. H. T. Townsend collector, is in the U. S. National Museum (Type No. 3354), Washington, D. C.

*Distribution.* *M. floris* is known only from Mexico and Guatemala. Cockerell (1899) records the species from the lower part of Rio Nautla, México. I have seen one specimen from Guatemala as follows: Secanquin, Alta Ver Paz, December, 1905, G. P. Goll collector (this specimen is in the U. S. National Museum).

### *Melissodes (Eumelissodes) denticulata* Smith

*Melissodes denticulata* Smith, 1854, Catalogue of the Hymenopterous Insects in the Collection of the British Museum, Part 2, p. 311.

*Melissodes senilis* Smith, 1854, Catalogue of the Hymenopterous Insects in the Collection of the British Museum, Part 2, p. 311; Provancher, 1888, Additions et Corrections au Volume II de la Faune entomologique du Canada traitant des Hyménoptères, p. 301.

*Melissodes perplexa* Cresson, 1878, Proc. Acad. Nat. Sci. Philadelphia, vol. 30, p. 206 (new synonymy); Robertson, 1892, Trans. Acad. Sci. St. Louis, vol. 5, p. 582; Bridwell, 1899, Trans. Kansas Acad. Sci., vol. 16, p. 211; Cockerell, 1899, Ent. News, vol. 14, p. 3; Viereck, 1903, Ent. News, vol. 14, p. 119; Cockerell, 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 88, 106, 113; Smith, 1910, Ann. Rep. New Jersey St. Museum for 1909, p. 693; Viereck, 1916, Connecticut Geol. Nat. Hist. Surv., Bull. 22, p. 732; Cresson, 1916, Mem. Amer. Ent. Soc., vol. 1, p. 127; Leonard, 1926, Cornell Univ. Agric. Exp. Sta. Mem. No. 101, p. 1028; Graenicher, 1930, Ann. Ent. Soc. Amer., vol. 23, p. 160; Brimley, 1938, Ins. North Carolina, p. 463.

*Melissodes vernoniana* Robertson, 1905, Trans. Amer. Ent. Soc. vol. 31, p. 368; 1914, Ent. News, vol. 25, p. 69; 1926, Ecology, vol. 7, p. 379; 1928, Flowers and Insects, p. 8; Pearson, 1933, Ecol. Monogr., vol. 3, p. 381.

*M. denticulata* and the following species, *M. vernoniae*, are highly distinctive bees and closely related. They seem to be more closely related to *coreopsis* than to any other *Eumelissodes*, but also bear certain resemblance to *rustica* and related species.

The female of *denticulata* and *vernoniae* both have peculiarly hooked branches on the scopal hairs as described below. Other species of *Eumelissodes* show this character developed to some degree (see *M. agilis*) but never to the extent shown by these two species. The males of *denticulata* and *vernoniae* have the clypeus white or partly white, rather than the usual yellow and have the metasomal tergal apices infumate to some degree. The males are also distinctive in the short hairs of the legs, particularly of the hind tibiae and basitarsi. Both sexes are sparsely clothed with hair and pubescence. *M. denticulata* is separated from *vernoniae* in the diagnosis of the latter.

*Female.* Measurements and ratios: N, 20; length, 10-12 mm.; width, 3.0-4.5 mm.; wing length,  $M = 3.11 \pm 0.173$  mm.; hooks in hamulus,  $M = 11.50 \pm 0.136$ ; flagellar segment 1/segment 2,  $M = 1.98 \pm 0.087$ .

Structure and color: Integument black except as follows: apical half of mandibles and distitarsi rufescent; eyes green to bluish green; flagellar segments 3-10 reddish beneath; wing membranes infumate, yellowish brown, veins black; tegulae piceous; tibial spurs yellow.

Clypeus evenly rounded, not protruding forward, oculoclypeal distance equals half minimum diameter first flagellar segment or less, with crowded round punctures separated mostly by half a puncture width or slightly more, surface opaque, densely tessellate; supraclypeal area with abundant punctures, densely tessellate; lateral areas of vertex with punctures separated by one puncture width or less, surface somewhat dulled by irregular shagreening; galeae opaque, densely tessellate, with hairs sparse and short; maxillary palpal ratio about 2.7:2.0:2.0:1.0. Thoracic sculpturing as in *coreopsis* except as follows: posteromedial area of mesoscutum often with small impunctate areas; surface mesoscutum and scutellum usually dulled by fine shagreening or minute tessellation. Metasomal tergum 1 with distinct punctures only in basal half or less, often separated by two to four puncture widths, occasionally a few scattered punctures at about half length of tergum and along sides almost to apex, surface dulled by fine, dense, reticulotransverse shagreening; tergum 2 with basal area punctures round, separated mostly by one to two puncture widths, surface dulled by fine reticular shagreening, interband zone with small, sparse, irregular-sized, shallow punctures, more abundant peripherally, surface dulled by reticulotransverse shagreening, apical

area impunctate or virtually so, surface as interband zone; tergum 3 similar to 2 but basal and interband zones more punctate, apical area with minute scattered shallow punctures in basal half separated mostly by three or more puncture widths; tergum 4 as in 3 but apical area reduced to small, triangular, medial area with minute punctures separated by about 2 puncture widths; pygidial plate V-shaped, longer than basal breadth.

**Hair:** Head white except abundant dark brown on vertex and on face to level of antennal fossae often mixed brown and white. Thorax white except as follows: scutellum black fringed with white; mesoscutum with large posteromedian brown patch equal twice scutellar dark patch and usually extending forward beyond a transverse line at anterior margins of tegulae; posterior pronotal lobes with at least a few black mixed with the white; tegulae with abundant dark hairs; mesepisterna often with black mixed with the white in upper angles. Metasomal tergum 1 with long sparse white hairs in punctate area, apical area glabrous; tergum 2 white basally, distal pubescence band white, usually interrupted medially so as to form lateral fasciae tapering medially, apical area glabrous or with minute, sparse, simple, closely appressed, brown hairs at least laterobasally, interband zone with appressed, short, simple, sparse, brown hairs; tergum 3 similar but basal tomentum brown, distal band usually not interrupted medially, apical area usually with more abundant short, simple, brown, appressed hairs and interband zone often with scattered white pubescence among the dark appressed hairs; tergum 4 similar to 3 but distal band apical and interrupted medially or almost so by inverted triangle of short, black, subappressed, simple hairs (often worn away); terga 5 and 6 dark brown with white lateral tufts; sterna brown, paler laterally. Legs white except as follows: distitarsi, fore and middle basitarsi, outer surface middle tibiae at least apically, inner surface hind basitarsi, and basitibial plates dark brown; inner surface hind tibiae yellowish red. Scopal hairs ochraceous to white, long, abundant, with branches in apical half almost to apex; branches bend away from rachis and then rather sharply distad to form a pronounced S-shape.

**Male.** Measurements and ratios: M, 20; length, 8-11 mm.; width, 2.5-3.5 mm.; wing length,  $M = 2.95 \pm 0.198$  mm.; hooks in hamulus,  $M = 10.75 \pm 0.216$ ; flagellar segment 2/segment 1,  $M = 7.06 \pm 0.142$ .

**Structure and color:** Integument black except as follows: clypeus black with apical margin testaceous and apical half, more or less,



white or cream-colored, pale macula usually trilobed along posterior margin, rarely mostly pale with only posterior margin infuscated, and also rarely mostly black; labrum usually with mediobasal pale spot one-third of area labrum or less in size; apical half of mandibles and distitarsi rufescent; eyes green to bluish green; flagellum yellow to red below except brown first segment; wing membranes slightly infumate, yellowish, veins dark brown; tegulae piceous; tibial spurs yellow; metasomal terga with apical areas piceous, occasionally somewhat reddened.

Minimum length first flagellar segment about one-seventh maximum length second segment, penultimate segment more than three times minimum width, flagellum in repose surpassing pterostigma; maxillary palpal ratio about 3.0:2.5:2.5:1.0. Sculpturing as in female except as follows: clypeal punctures usually larger and shallower; mesoscutum often more abundantly punctate; tergum 1 with basal three-fifths punctate, punctures separated by less than one puncture width mediobasally, sparser and smaller toward apex; tergum 2 with basal area punctures larger, separated by half to one puncture width, interband zone punctures separated mostly by two puncture widths, terga 4 and 5 similar to tergum 3; sterna with reticular shagreening. Terminalia as in *vernoniae*.

Hair: Head white except abundant brown on vertex. Thorax white except scutellum brown fringed with white and large postero-medial mesoscutal brown patch often extending forward to a transverse line at anterior margins of tegulae; tegulae often brown; tergum 1 white basally, apical area with short simple, appressed to subappressed, sparse, brown hairs; tergum 2 as in female but distal pale band often not interrupted and interband and apical area hairs subappressed to suberect and usually longer; terga 3-5 similar to 2 but brown basally; terga 6 and 7 brown; sterna ochraceous to brown medially, paler laterally. Legs white except as follows: distitarsi, fore basitarsi, inner surfaces middle basitarsi brown; inner surface hind basitarsi yellow to red. Hairs of hind basitarsi and tibiae (outer surfaces) short, on tibia no longer than width of tibia, on basitarsus less than twice width of basitarsus.

*Bionomics.* This species is an oligolege on species of the genus *Vernonia* (Compositae) and seemingly is dependent upon this as a source of pollen. Table X gives a brief summary of the floral data available to the author.

*Type Material.* The holotype male of *denticulata* from North America is in the collection of the British Museum (Natural History)

(Type No. 17 B 833), London, England. The holotype female of *senilis* from Mount Pleasant, Ohio, is in the British Museum (Natural History) (Type No. 17 A 2618), London, England. Smith (1854, p. 311) at the end of the description of *senilis* states that it comes from the same locality as *denticulata* and is probably the same species, however, he does not state the exact locality for *denticulata* nor is the information on the type itself. Lectotype female of *perplexa* from Georgia is in the collection of the Academy of Natural Sciences of Philadelphia, Pennsylvania (with three female and four male paratypes). Lectotype female, here designated, and lectoallotype male, here designated, of *vernoniana*, from Carlinville, Illinois, collected by Charles A. Robertson, August 7, 1899, on

TABLE X. Summary of Floral Data for *Melissodes denticulata*.

Plant Data			Records of <i>M. denticulata</i>			
FAMILY	Number of genera	Number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae: <i>Vernonia</i> spp.	1	7	84	245	72	317
Other genera	6	6	7	1	13	14
Verbenaceae	1	2	4	0	25	25
Other families (3)	4	4	4	1	3	4
Totals	12	19	99	247	113	360

*Verbena stricta*, are in the collection of the Illinois Natural History Survey, Urbana, Illinois.

*Distribution.* *M. denticulata* ranges from southern Canada west to Ontario and south to Texas and Florida (Fig. 22). It has been collected from May 17 to October 18, but chiefly during August. In addition to the type specimens, 464 females and 272 males have been examined from the localities listed below. Of published records, only those verified by the author are included in this list.

ALABAMA: Colta; Decatur. ARKANSAS: Hope; Knob Hill Reservation; Marion Co. CONNECTICUT: Mystic. DISTRICT OF COLUMBIA: Washington; Woodridge. FLORIDA: Yankeetown. GEORGIA: Lav-

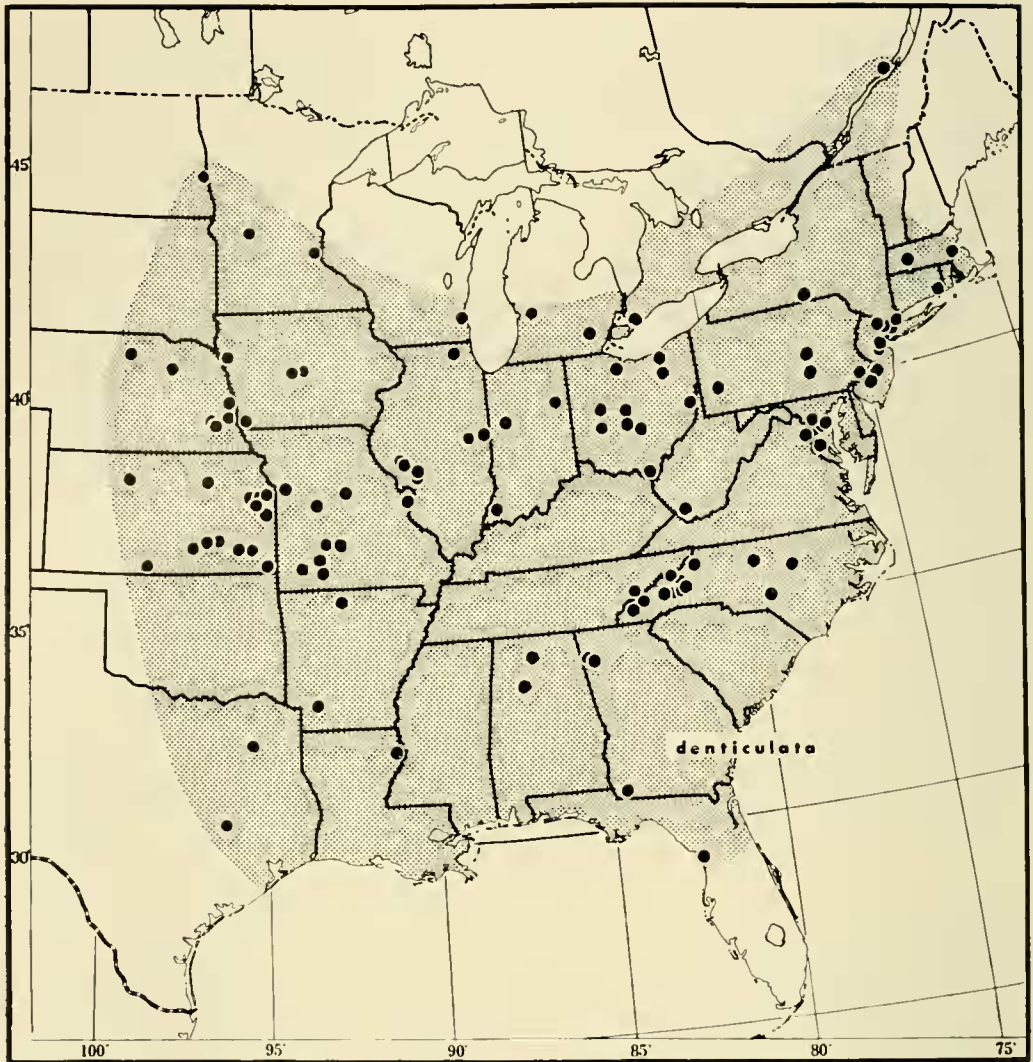


FIG. 22. Map showing the known distribution of *M. (Eumelissodes) denticulata* Smith.

ender, Floyd Co.; Rome; Spring Creek, Decatur Co. ILLINOIS: Algonquin; Bluffs, Scott Co.; Carlinville; Champaign Co.; Danville, Macoupin Co.; Scott Co. INDIANA: Bluffton; Fort Branch. IOWA: Ames; Fremont Co.; Ledges State Park; Sioux City. KANSAS: Baldwin; Barber Co.; Cherokee Co.; DeSoto, Johnson Co.; Douglas Co.; El Dorado; Lawrence; Neosho Co.; Osawatomie; Reece; Riley Co.; Rooks Co.; Sunflower (10 miles E. of Lawrence); Wichita (Air Force Base); Wilson Co. LOUISIANA: Tallulah. MARYLAND: Cabin John; Glen Echo; Indian Head; Patuxent. MASSACHUSETTS: Chicopee; Forest Hills. MICHIGAN: Ann Arbor; Grand Rapids. MINNESOTA: Grey Eagle; St. Anthony Park, Ramsey Co. MISSOURI: Atherton; Buffalo; Columbia; Lebanon; Ozark; St. Louis; Sedalia; Springfield; Verona. NEBRASKA: Lincoln; Louisville; Malcolm; Neligh; Omaha; Rock Co. NEW JERSEY: Alpine, Bergen Co.; Clementon; Jamesburg;



New Brunswick; Pemberton; Ramsey; Riverton. NEW YORK: Bronx; New Rochelle; Sheephead; Staten Island; Tioga Co. NORTH CAROLINA: Asheville; Barber; Black Mts. (Valley of); Bryson City; Busick; Greensboro; Marion; Mt. Mitchell Game Refuge; Nontahala Gorge; Raleigh; Southern Pines; Swannanoa; Watauga Co.; Yancy Co. NORTH DAKOTA: Fargo. OHIO: Barberton; Cleveland; Delaware Co.; Franklin Co.; Fremont; Ironton; Logan Co.; Mount Pleasant; Pickerington; Springfield. PENNSYLVANIA: Highspire; North Braddock; Northcumberland; Philadelphia. TENNESSEE: Great Smoky Mountain National Park; Hattiesburg. TEXAS: Brazos Co.; Mineola. VIRGINIA: Barcroft; Falls Church; Glencarlyn; Goshen; Rosslyn (along Potomac River). WEST VIRGINIA: Baileysville. WISCONSIN: Milwaukee. *Canada*. ONTARIO: Chatham. QUEBEC: Cap Rouge. In addition to the above, two males doubtfully labeled have been examined; one from Monticello, Utah, collected by G. F. Knowlton and G. E. Bohart, July 15, 1952, and the second from Pullman, Washington, collected by C. V. Piper. The author is quite certain that the Washington specimen was mislabeled; however, the Utah specimen could well be a stray male carried out of range by man or blown there by storms.

*Flower Records.* *Amphiachyris dracunculoides*, *Carduus crispus*, *Convolvulus sepium*, *Eupatorium purpurea*, *Ipomoea pandurata*, *Pycnanthemum* sp., *Silphium* sp., *S. laciniatum*, *Solidago juncea*, *Symphoricarpos* sp., *Verbena* sp., *V. hastata*, *V. stricta*, *Vernonia* sp., *V. altissima*, *V. baldwini*, *V. b. interior*, *V. fasciculata*, *V. glauca*, *V. noveboracensis*, *V. texana*.

*Melissodes (Eumelissodes) vernoniae* Robertson

*Melissodes vernoniae* Robertson, 1902, Canadian Ent., vol. 34, p. 323; 1905, Trans. Amer. Ent. Soc., vol. 31, p. 368; Cockerell, 1909, Ann. Mag. Nat. Hist., ser. 8, vol. 4, p. 26; Graenicher, 1911, Bull. Pub. Museum Milwaukee, vol. 1, p. 247; Robertson, 1914, Ent. News, vol. 25, p. 69; 1926, Ecology, vol. 7, p. 379; 1928, Flowers and Insects, p. 8; Pearson, 1933, Ecol. Monogr., vol. 3, p. 378; Graenicher, 1935, Ann. Ent. Soc. Amer., vol. 28, p. 304. *Melissodes confusiformis incondita* Cockerell, 1925, Ann. Mag. Nat. Hist., ser. 9, vol. 16 (new synonymy); 1928, Univ. Colorado Studies, vol. 16, p. 114.

*M. vernoniae* is closely related to *denticulata* but averages somewhat larger in size and paler in color. The female of *vernoniae* can be told from that of *denticulata* by the usual lack of dark hairs mixed with the pale on the posterior pronotal lobes and the mesepisterna (although not in all specimens), and the clear, colorless or slightly milky wing membranes. The male of *vernoniae* is readily distinguished from that of *denticulata* by the shorter an-

tennae and slightly longer first flagellar segments, the clypeus usually being entirely pale, and by the mandibles usually having pale basal maculae.

*Female.* Measurements and ratios: N, 20; length, 11-15 mm.; width, 4.0-5.5 mm.; wing length,  $M = 3.85 \pm 0.152$  mm.; hooks in hamulus,  $M = 13.95 \pm 0.276$ ; flagellar segment 1/segment 2,  $M = 1.90 \pm 0.022$ .

Structure and color: Integumental color as in *denticulata* except as follows: often entire legs except coxae rufescent; eyes gray to bluish gray; wing membranes clear, colorless or slightly milky, veins usually reddish brown; tergum 1 with extremely narrow hyaline apical margin.

Structure and sculpturing as in *denticulata* except as follows: supraclypeal area often moderately shiny; lateral areas of vertex with punctures separated by one to two puncture widths, shiny, shagreening slight; maxillary palpal ratio about 3.0:2.7:2.0:1.0; tergum 1 with punctures of basal half mostly separated by one puncture width or less; tergum 2 with basal area punctures separated mostly by less than one puncture width; tergum 4 with apicomedial, inverted triangular area lacking.

Hair: Head white except abundant brown on vertex. Thorax white except scutellum brown fringed with white, mesoscutum with large posteromedian brown patch which usually extends forward at least to a transverse line at anterior margins of tegulae (occasionally smaller), and pale anterior mesoscutal hairs usually ochraceous; occasionally with brown mixed with white on posterior pronotal lobes; tegulae usually with brown. Metasomal hairs as in *denticulata* except as follows: tergum 2 with distal band broader and occasionally not interrupted medially or only narrowly so, interband zone and apical area hairs when present pale, brown; terga 3 and 4 with broader distal pale bands and tergum 4 with inverted triangular, apicomedial area of simple brown hairs lacking. Legs as in *denticulata* but with less brown; tibiae often without brown on outer surfaces; inner surface hind basitarsi often reddish brown; scopal hairs as in *denticulata*.

*Male.* Measurements and ratios: N, 20; length, 10-14 mm.; width, 3.0-4.5 mm.; wing length,  $M = 3.78 \pm 0.215$  mm.; hooks in hamulus,  $M = 13.15 \pm 0.166$ ; flagellar segment 2/segment 1,  $M = 5.80 \pm 0.101$ .

Structure and color: Integumental color as in *denticulata* except as follows: clypeus usually entirely white or cream-colored except

testaceous apical margin and dark tentorial pits, occasionally infuscated along posterior margin between tentorial pits (especially in specimens from Missouri); labrum with pale mediobasal spot; mandibles usually with basal white maculae; distitarsi and often basitarsi and tibiae rufescent; terga with apical margins usually broadly hyaline, colorless or yellow, occasionally infumate and rarely piceous; wing membranes clear, colorless, veins reddish brown to brown.

Minimum length first flagellar segment about one-sixth maximum length second segment or more, penultimate segment slightly more than three times as long as broad, flagellum in repose usually not quite reaching pterostigma and never surpassing. Maxillary palpal ratio about 8:5:4:1. Sculpturing as in female except as follows: basal half of galeae occasionally shiny and unshagreened; posteromedial mesoscutal impunctate area reduced and often absent; tergum 1 punctate in basal three-fifths, punctures separated mostly by two or more puncture widths. Terminalia as in *agilis* (Figs. 92-95).

Hair: Head white but often with brown on vertex. Thorax white to ochraceous (above) with abundant brown on scutellum and posteromedial mesoscutal brown patch equals twice scutellar dark patch or less, occasionally with no or very few brown hairs on mesoscutum; tegulae usually with brown. Metasomal hairs as in *denticulata* but tergum 2 with distal pale band usually not interrupted medially, terga 3 and 4 with distal pale bands usually broader, and tergum 5 usually with a complete distal pale band. Legs as in *denticulata*.

*Bionomics.* *M. vernoniae*, as the name implies, is an oligolege of the genus *Vernonia* (Compositae) and, like its relative *M. denticulata*, is seemingly dependent upon that genus as a source of pollen. However, *vernoniae* has been collected more often on other plants than has *denticulata* and it seems probable that it may use pollen from *Helianthus* spp. and possibly *Ipomoea* spp. on occasion. Table XI summarizes the available floral data.

*Type Material.* Lectotype female, here designated, August 19, 1902, and lectoallotype male, here designated, August 16, 1902, both collected by Charles A. Robertson on *Vernonia fasciculata* at Carlinville, Illinois, are in the collection of the Illinois Natural History Survey, Urbana. Sixteen female and sixteen male paratypes from the same flower and locality are with the lectotypes. Holotype female of *confusiformis incondita* from Wray, Colorado, collected by



TABLE XI. Summary of Floral Data for *Melissodes vernoniae*.

Plant Data			Records of <i>M. vernoniae</i>			
FAMILY	Number of genera	Number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae: <i>Vernonia</i> spp.	1	5	59	345	142	487
Other genera	8	10	16	13	5	18
Other families (5)	6	6	9	22	8	30
Totals	15	21	84	380	155	535

F. E. Lutz on August 17-19, 1919, is in the collection of the American Museum of Natural History, New York City.

*Distribution.* The species ranges from Indiana and North Dakota west to southern Idaho and south to New Mexico and Texas (Fig. 23). It has been collected from May 30 to September, but chiefly in July and August. In addition to the types, 480 females and 253 males have been examined from the localities listed below. This list includes only those published records verified by the author.

ARKANSAS: Lawrence Co.; Marion Co. COLORADO: Denver; Fort Collins; Wray. IDAHO: Franklin. ILLINOIS: Carlinville; Champaign; Danville; Macoupin Co.; Monticello; Peoria; White Hall. INDIANA: Fort Branch. IOWA: Ames; Ledges State Park. KANSAS: Allen Co.; Anderson Co.; Baldwin; Butler Co.; Clay Center; Delavan (5 miles E.); Harvey Co.; Iola; Kingman Co.; Labette Co.; Lake View, Douglas Co.; Lawrence; Linn, Washington Co.; Manhattan; Neosho Co.; Olathe; Onaga; Osawatomie; Osborne Co.; Ottawa; Riley Co.; Scott Co.; Sunflower (10 miles E. of Lawrence); Topeka; Washington Co.; Wellington; Wichita (Air Force Base); Wilson Co. MISSOURI: Buffalo; Columbia; Lebanon; Ozark; St. Louis; Smithton, Pettis Co.; Strasburg (5 miles W.); Verona. NEBRASKA: Aurora; Carns; Fairmont; Glen, Sioux Co.; Hardy; Lincoln; Louisville; Malcolm; McCool; Omaha. NEW MEXICO: Quemado; Roswell. NORTH DAKOTA: Fargo. SOUTH DAKOTA: Custer. TEXAS: Alpine; Blanco Co.; Brazos Co.; Clarendon; Comfort; Conlen; Dallas; Davis Mts. (Limpia Canyon); Dawn; Fedor, Lee Co.; Fort Davis, Jeff Davis Co.; Hereford (5 miles S. W.); Llano; Waco.

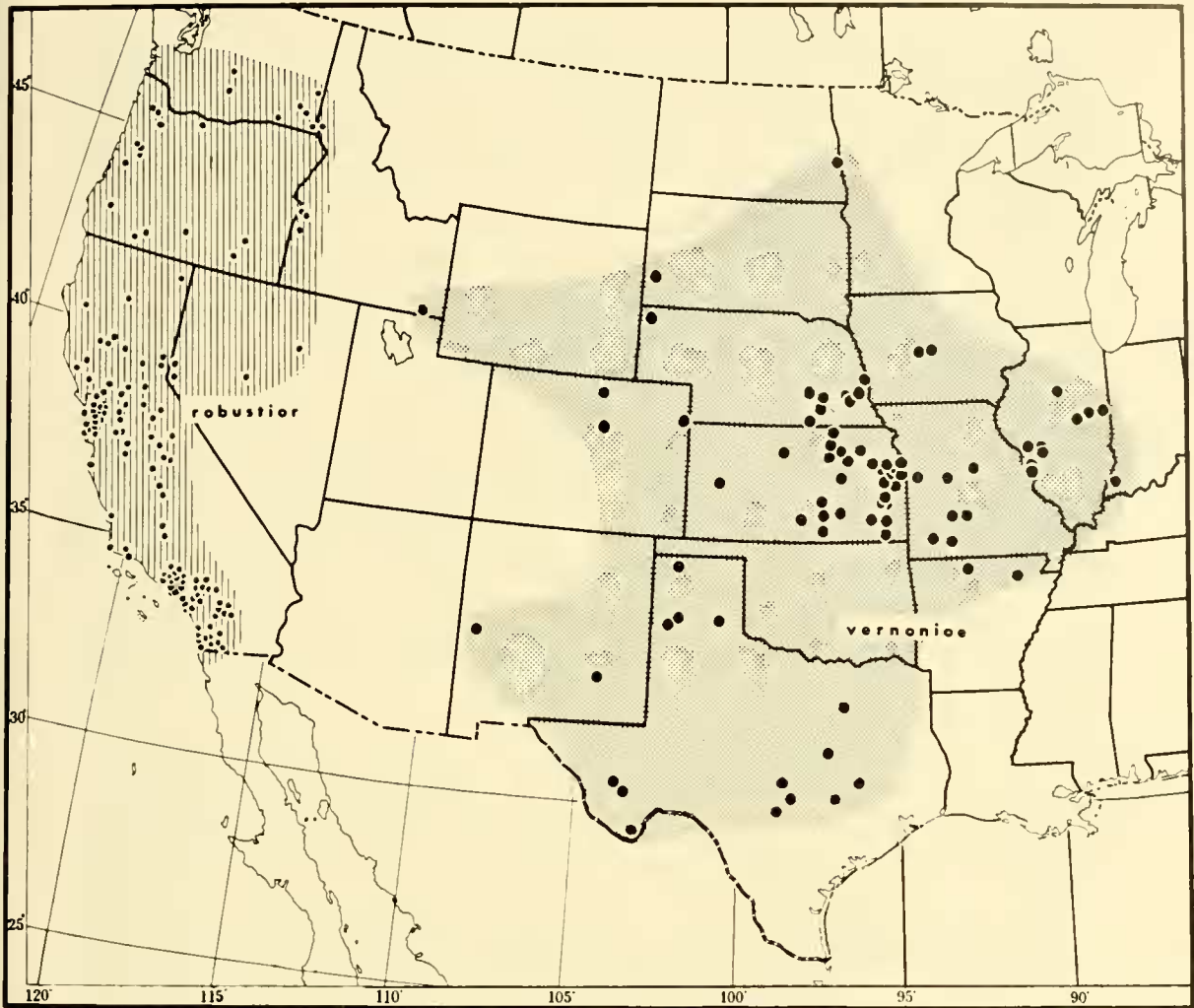


FIG. 23. Map showing the known distributions of *M. (Eumelissodes) vernoniae* Robertson and *M. (E.) robustior* Cockerell.

*Flower Records.* *Bidens* sp., *Gaillardia pulchella*, *Grindelia* sp., *Helianthus* sp., *H. tuberosus*, *Heliopsis helianthoides*, *Ipomoea pandurata*, *Lacinaria* sp., *Lactuca pulchella*, *Liatris* sp., *Monarda fistulosa*, *Polygonum* sp., *Rudbeckia* sp., *R. hirta*, *Silphium laciniatum*, *S. speciosum*, *Verbena* sp., *V. stricta*, *Vernonia* sp., *V. altissima*, *V. fasciculata*, *V. interior baldwini*, *V. longifolia*, *V. texana*.

*Melissodes (Eumelissodes) robustior* Cockerell

*Melissodes robustior* Cockerell, 1915, Ann. Mag. Nat. Hist., ser. 8, vol. 16, p. 482; 1930, Ann. Mag. Nat. Hist., ser. 10, vol. 5, p. 405.

This is one of the most abundant species of *Eumelissodes* found along the Pacific Coast. It is a medium-sized to large bee related to *M. coreopsis*, although not closely. The female is like that of *coreopsis* in color and sculpture but have the galeae dulled by dense

tessellation, the pale vestiture ochraceous to dull rufescent, abundant dark hairs on the tegulae, and wings with reddish brown veins and slightly infumate (yellowish) membranes. The male of *robustior* is readily distinguished from that of *coreopsis* by the longer first flagellar segments, the tessellate galeae, and the yellowish wing membranes.

*Female.* Measurements and ratios: N, 20; length 10-15 mm.; width, 3.5-5.5 mm.; wing length,  $M = 4.13 \pm 0.261$  mm.; hooks in hamulus,  $M = 14.70 \pm 0.262$ ; flagellar segment 1/segment 2,  $M = 2.03 \pm 0.027$ .

Structure and color: Integument black except as follows: apical half of mandibles and distitarsi rufescent; flagellar segments 3-10 red to reddish brown below; eyes dark gray to slightly greenish gray; tegulae piceous to somewhat rufescent; wing membranes hyaline, slightly infumate, yellowed, veins dark reddish brown; tibial spurs yellow to rufescent; tergum 1 rufescent to translucent-yellow apically.

Structure and sculpture as in *coreopsis* except as follows: clypeal punctures irregularly round, crowded, separated mostly by half a puncture width or less, surface dulled by coarse shagreening; supraclypeal area usually dulled by fine reticular shagreening, with few or no punctures medially; lateral areas of vertex with punctures minute, separated by three or four puncture widths or more, surface shiny; galeae opaque above, dulled by dense tessellation and distinct punctures; maxillary palpal ratio about 9:8:7:1, fourth segment occasionally slightly longer, occasionally virtually absent. Mesoscutal punctures small, round, posteromedially separated mostly by half to two puncture widths, surface unshagreened; scutellum similar; mesepisternal punctures larger, extremely shallow, often with bottoms slightly dulled and surface dulled by fine irregular shagreening. Metasomal sculpturing as in *coreopsis* except as follows: tergum 1 with basal three-fifths with punctures separated mostly by one to two puncture widths; tergum 2 with basal area punctures small, separated mostly by one to two puncture widths, surface with fine reticular shagreening, interband zone punctures small, separated mostly by two to three puncture widths, surface reticularly shagreened, apical area impunctate; terga 3 and 4 similar but interband zone punctures more crowded. Pygidial plate V-shaped, longer than broad.

Hair: Head white to pale ochraceous with brown on vertex and ochraceous on occipital area. Thorax pale ochraceous to white



laterally and posteriorly, ochraceous above with scutellum dark brown and ochraceous peripherally and mesoscutum with postero-median dark brown patch usually twice as large as scutellar, but often less; tegulae with dark brown. Tergum 1 ochraceous to pale ochraceous basally, glabrous apically; tergum 2 with basal area white, distal pale band white to pale ochraceous, broad, usually not interrupted medially although narrowed or notched posteriorly, interband zone with abundant, short, erect, dark brown hairs, apical area with short, suberect to appressed, dark brown hairs, tergum 3 similar to 2 but basal tomentum brown, distal pale band broader and often reaching apical margin at extreme sides; tergum 4 with pale band distal, not interrupted medially or fringed with dark; terga 5 and 6 with pale lateral tufts; sterna yellow to pale brown medially, white laterally. Legs pale ochraceous except as follows: outer surfaces fore and middle tarsi, outer-apical surfaces fore and middle tibiae, and basitibial plates brown; inner surfaces fore and middle tarsi reddish brown; inner surfaces hind basitarsi dark red to reddish brown; inner surfaces hind tibiae yellow.

*Male.* Measurements and ratios: N, 20; length, 10-14 mm.; width, 3-4 mm.; wing length,  $M = 3.80 \pm 0.149$  mm.; hooks in hamulus,  $M = 13.60 \pm 0.239$ ; flagellar segment 2/segment 1,  $M = 3.87 \pm 0.064$ .

Structure and color: Integument black except as follows: clypeus yellow except testaceous apical border and dark tentorial pits; labrum with mediobasal spot; mandibles without basal yellow spots; flagellar segments 2-11 yellow to red beneath, segment 1 occasionally red; apical half of mandibles and tarsi rufescent; eyes brown to yellowish green or gray; wing membranes clear, slightly infumate, yellowish especially in vicinity of veins, veins dark red to reddish brown; tegulae piceous; tibial spurs yellow to red; tergal apices hyaline, colorless to yellow.

Clypeus as in *coreopsis*; supraclypeal area and galeae as in female; minimum length first flagellar segment usually equals one-fourth to one-fifth maximum length second segment; maxillary palpal ratio about 9:8:6:1, fourth segment often virtually absent. Mesosomal and metasomal sculpture as in female except as follows: tergum 1 with basal four-fifths punctate; tergum 2 with interband zone punctures slightly larger and separated mostly by two to three puncture widths; terga 4 and 5 like tergum 2. Terminalia as in *agilis* but sternum 8 with ventral tubercle lamellate, not strongly pointed near apex.

Hair: Clypeus and genal areas white to pale ochraceous, vertex ochraceous, often with brown. Thorax ochraceous above, paler laterally and posteriorly; scutellum with abundant brown hairs medially; mesoscutum with posteromedial brown patch at least equal in area to scutellar dark patch and often twice as large; tegulae with brown hairs. Tergum 1 with long pale ochraceous hairs basally, reaching margin across entire tergum, appressed apically; tergum 2 white to pale ochraceous basally, distal pale pubescent band narrow and often interrupted medially, interband zone hairs long, erect to suberect, pale ochraceous, apical area hairs usually abundant (often worn away), suberect to appressed, pale ochraceous; terga 3-5 similar to 2 but distal pale bands not interrupted and progressively closer to apical margin, often apical on tergum 5; terga 6 and 7 ochraceous to golden; sterna yellow medially to almost white or pale ochraceous laterally. Legs pale ochraceous to white except inner surfaces tarsi yellow.

*Bionomics.* *M. robustior* is a composite oligolege and seems to prefer the genus *Helianthus* to all others. Considerable flower data are available and these are summarized in the table XII below.

*Type Material.* Holotype female of *robustior* from Berkeley, California, collected by T. D. A. Cockerell, August 9, 1915, on *Helian-*

TABLE XII. Flower Data for *Melissodes robustior*.

Plant Data			Records of <i>M. robustior</i>			
FAMILY	Number of genera	Number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae:						
<i>Helianthus</i> spp.	1	5	63	60	118	178
<i>Coreopsis</i> spp.	1	3	40	19	56	75
<i>Cosmos</i> sp.	1	1	11	24	8	32
<i>Heterotheca</i> sp.	1	1	10	5	6	11
Other genera	18	24	66	40	86	126
Other families (6)	6	7	7	0	8	8
Totals	28	41	197	148	282	430

*thus annuus*, is in the collection of the U. S. National Museum, Washington, D. C.

*Distribution.* *M. robustior* ranges throughout the Pacific Coast States east to Idaho and Nevada (Fig. 23). It has been collected from May 2 to October 29, but chiefly in June, July and August. In addition to the holotype, 296 females and 659 males were examined from the localities listed below.

CALIFORNIA: Alameda; Alameda Foothills, Altadena; Alum Rock Park, Santa Clara Co.; Anaheim; Antioch; Anza (2 miles E.); Artesia; Artois; Arvin; Auburn; Avon; Bakersfield; Banning; Bayliss; Berkeley; Big Dalton Dam, Los Angeles Co.; Brisbane; Calistoga; Calpine; Carmel; Clear Lake; Cloverdale; Clovis; Contra Costa Co.; Corona; Coronado; Davis; Dinkey Ranger Station, Fresno Co.; Dos Palos; Eagle Rock Hills, Los Angeles Co.; Echo Lake, Shasta Co.; El Toro; Encinitas; Gavilon; Glendale; Glenn Co.; Hagerman Park, Merced Co.; Hallelujah Junction; Hamilton City; Hayward; Hemet; Hillsboro; Huntington Park; Idlewild; Indio; Irvington; Jacumba; Laguna Beach; Laguna Mt., San Diego Co.; Lake City; Lake Tahoe; Lindsay; Lodi; Lompoc; Los Angeles; Los Angeles Co.; Mariposa Co.; Marsh Creek Canyon, Contra Costa Co.; Martinez; Midway City; Mill Creek; San Bernardino Co.; Mira Loma; Mokelumna Hill; Morro Bay; Mountain View; Mount Diablo; Newport Beach; Nippinnawassee, Madera Co.; Oak Grove; San Diego Co.; Oakland; Oakley; Oceanside; Ontario (6 mi. E.); Oroville; Pasadena; Patterson; Pine Crest; Pine Valley; Poway; Rawhide; Redlands; Redwood City; Rialto; Riverside; Rivera; Sacramento; Sacramento Co.; San Bernardino Co.; San Bernardino Mts.; San Diego; San Diego Co.; San Francisco; San Gabriel Mts.; San Jose; Santa Barbara; Santa Barbara Foothills; Santa Cruz Mts.; Santa Monica; Shaver Lake, Fresno Co.; Sierraville; Sierra Madre (near Los Angeles); Snowline Camp, Eldorado Co.; Stanford University; Stockton; Tanbark Flat, Los Angeles Co.; Turlock; Twain Harts, Tuolumne Co.; Upper Santa Ana River, San Bernardino Co.; Vacaville, Vallejo; Vandervanter Flat, San Jacinto Mts.; Vernalis; Visalia; Warrens; West Hollywood Hills; Westwood Hills, Los Angeles Co.; Whittier; Wrightwood; Yosemite National Park (Crane Flat); Yucaipa. IDAHO: Lewiston; Parma; Regina (12 miles N. W.); Squaw Creek (10 miles E. of Emmet), Gem Co. NEVADA: Austin; Elko; Reno. OREGON: Aurora; Bane Island, Klamath Lake; Blooming; Catlow Valley, Harney Co.; Cornelius; Corvallis; Fish Lake; Lane Co.; Riddle; Salem; Shedd; Summer Lake; Ten Cent Lake (dry),



East of Steens Mts.; The Dalles (14 miles E.). WASHINGTON: Asotin (Snake River); Lone Tree, Yakima River; North Yakima; Penawawa; Walla Walla; Wawawai.

*Flower Records.* *Asclepias* sp., *Aster* sp., *Brassica adpressa*, *B. incana*, *Centromadia pungens*, *Chaenactis artemesiaefoliae*, *C. glabiuscula*, *Chrysothamnus* sp., *Cichorium* sp., *Cirsium* sp., *C. lanceolatum*, *Coreopsis* sp., *C. grandifolia*, *C. lanceolata*, *C. tinctoria*, *Corethrogyne* sp., *C. bernardense*, *Cosmos* sp., *Encelia* sp., *E. californica*, *E. farinosa*, *Ericameria palmeri*, *Gaillardia* sp., *Goddetia bottae*, *Grindelia* sp., *G. camporum*, *G. eleta*, *Gutierrezia californica*, *G. sarothrae*, *Helianthus* sp., *H. annuus*, *H. bolanderi*, *H. gracilenthus*, *H. lenticularis*, *H. petiolaris*, *Hemizonia* sp., *H. paniculata*, *H. wrightii*, *Heterotheca grandiflora*, *Isocoma vernonioides*, *Lactuca* sp., *Lythrum californicum*, *Marrubium vulgare*, *Scabiosa atropurpurea*, *Senecio* sp., *S. douglasii*, *Solidago* sp., *S. californica*, *Stephanomeria* sp., *S. exigua*.

*Melissodes (Eumelissodes) hurdi*, n. sp.

This medium-sized bee from California is a close relative of *M. robustior*. It has been named in honor of Dr. P. D. Hurd of the University of California who collected the holotype and many of the paratypes and who has collected many species of *Melissodes* in California, Arizona and Mexico. The females of *hurdi* can be separated from those of *robustior* by the lack of brown mesoscutal, tegular and scutellar hairs (although there occasionally are a few dark scutellar hairs), by the fine but conspicuous punctures of the apical areas of terga 2 and 3, and by the colorless wings. The males of *hurdi* are distinctive in the partially black clypeus, the strongly crenulate flagellum, the dulled galeae, and the suberect dark hairs of the apical areas of terga 2 to 4.

*Female.* Measurements and ratios: N, 20; length 10-13 mm.; width, 4-5 mm.; wing length,  $M = 3.59 \pm 0.224$  mm.; hooks in hamulus,  $M = 15.35 \pm 0.233$ ; flagellar segment 1/segment 2,  $M = 2.11 \pm 0.028$ .

Structure and color: Integumental color as in *robustior* except as follows: wing membranes colorless to milky, veins dark brown to black. Structure and sculpture as in *robustior* except as follows: clypeal surface only slightly dulled by fine reticular shagreening; supraclypeal area with a few large punctures medially, shiny, with fine irregular shagreening; galeae tessellate above; maxillary palpal ratio about 3.8:3.4:2.4:1.0; second flagellar segment as long below

as maximum width or shorter; metasomal tergum 1 with basal four-fifths or slightly less with round punctures separated mostly by half to one puncture width, apical area impunctate with small antero-lateral impunctate or sparsely punctate lobes; tergum 2 with basal area punctures separated by one puncture width or slightly more, interband zone punctures small, separated by one to two puncture widths, apical area with minute but distinct punctures separated mostly by three puncture widths, surface shiny; tergum 3 similar to 2 but interband zone punctures denser and apical area punctures separated mostly by one to two puncture widths; pygidial plate V-shaped, apex rounded, longer than broad.

Hair: Head white to pale ochraceous with sparse brown hairs on vertex. Thorax white to pale ochraceous laterally, ochraceous dorsally, occasionally a few brown hairs medially on scutellum. Metasomal vestiture as in *robustior* except as follows: tergum 1 with long, appressed, ochraceous to white, barbed hairs reaching from apical margin of punctate area to apical margin of tergum forming pale apical band (unless worn), pale ochraceous basally; tergum 2 with interband zone hairs suberect to erect, pale ochraceous to white, distal pale band white to pale ochraceous, not reaching apex of tergum except occasionally at extreme sides, longer medially than apical area, apical area with abundant, suberect, simple, dark brown hairs; tergum 3 similar to 2 but interband zone erect hairs at least partly brown and apical area shorter and usually lacking laterally; tergum 4 like 3 but lacking apical area; terga 5 and 6 dark brown with pale lateral tufts. Legs as in *robustior* except as follows: outer surfaces middle basitarsi pale ochraceous; inner surfaces hind basitarsi red to reddish brown.

*Male.* Measurements and ratios: N, 20; length, 9-13 mm.; width, 2.5-4.0 mm.; wing length,  $M = 3.44 \pm 0.135$  mm.; hooks in hamulus,  $M = 12.94 \pm 0.211$ ; flagellar segment 2/segment 1,  $M = 5.88 \pm 0.111$ .

Structure and color: Integumental color as in *robustior* except as follows: clypeus light yellow with brown apical border and infuscated posterior margin to posterior two-thirds black; labrum black; flagellar segment 1 and base of 2 brown; eyes yellowish green (holotype) to gray; wing membranes colorless or milky, veins dark red to brown.

Structure as in *robustior* except as follows: minimum length first flagellar segment one-fourth to one-fifth maximum length second segment, penultimate segment more than three times as long

as broad, segments 3 or 4 to 10 strongly crenulated by basal constrictions; maxillary palpal ratio about 4.0:3.8:3.0:1.0; sternum 6 with distinct subapical carinae but these less than half as long as distance between their distal tips and sternum with distinct median shiny sulcus. Sculpture as in female except as follows: clypeal punctures less distinct; tergum 1 punctate almost to apical margin but punctures smaller in last fifth; terga 2-4 with interband zone punctures coarser and apical area punctures less distinct. Terminalia as in *agilis* but sternum 8 with ventral tubercle lamellate and strongly pointed apically, higher than in *robustior*.

Hair: Head and thorax white to pale ochraceous, occasionally with brown on scutellum (holotype). Metasomal vestiture as in *robustior* except as follows: tergum 1 often (holotype) with some apicomedian hairs brown; tergum 2 with distal pale band subequal in length to apical area medially, uninterrupted, apical area with abundant, suberect, dark brown hairs; terga 3 and 4 similar to 2 but apical areas progressively shorter and on tergum 4 distal pale band reaches margin of tergum laterally; tergum 5 similar but lacking apical area; terga 6 and 7 brown to ochraceous. Legs as in *robustior*.

Notes. In spite of the resemblance of *M. hurdi* to *M. robustior*, *hurdi* is perhaps more closely related to the *menuachus* group as is indicated by the crenulate male antennae, the pale distal band on tergum 1 of the female and the lack of brown mesoscutal hairs on both sexes. The *menuachus* group seems to relate to the *coreopsis* group through the *robustior* group of species, therefore including *hurdi* in the same group with *robustior* does no violence to the phylogeny of the genus.

*Type Material.* The holotype male, allotype female, and four female paratypes were collected at Antioch, California, August 9, 1947, by P. D. Hurd. In addition, 41 female and 29 male paratypes from Antioch, California, are as follows (given by year collected); 1934: 1 female, September 14, B. J. Hall; 2 females and 3 males, September 9, G. E. and R. M. Bohart. 1935: 1 male, September 15, G. E. and R. M. Bohart. 1936: 2 females, August 23, 2 females and 1 male, August 30, 2 females, September 9, 2 females, September 13, 2 females, October 17, E. C. Van Dyke; 1 female on *Erigonum* sp., 1 female on *Grindelia* sp., 1 female in sand dunes, and 1 male on *Gutierrezia californica*, September 12, E. G. Linsley; 1 female, September 5, 1 female, September 10, M. A. Cazier; 1 female, August 8, 1 female and 1 male, August 9, C. D. Michener; 1 male, August 10, 1 female, October 10, G. E. Bohart; 1 male, September



10, G. E. and R. M. Bohart; 2 males, September 20, G. Ferguson. 1937: 1 male, September 26, K. S. Snyder; 1 female, July 15, 1 female, October 10, E. C. Van Dyke. 1938: 1 female, September 9, T. Aitken; 1 female, September 9, E. C. Van Dyke. 1939: 1 male, September 16, B. Brookman. 1947: 1 female and 1 male, October 13, 2 males, September 10, P. D. Hurd. 1948: 1 male, September 8, J. W. MacSwain; 2 males, September 8, 1 female and 1 male, October 24, P. D. Hurd; 1 female, October 24, W. W. Wirth. 1950: 1 male, August 11, P. D. Hurd; 1 female, August 10, J. E. Gillaspay. 1951: 1 female, September 25, J. G. Rozen. 1953: 1 male, October 17. 1954: 1 male, August 15, H. E. and M. A. Evans; 2 females, October 14, A. M. Barnes; 1 female, October 14, M. Wasbauer; 5 females on *Lessingia glandulifera*, October 14, P. D. Hurd. 1955: 2 females, October 25, D. Burdick; 1 male, August 25, C. D. MacNeil. The holotype and allotype are in the collection of the University of California at Berkeley. Paratypes are with the holotype and in the collection of P. H. Timberlake, Riverside, California, the University of California at Davis, the California Academy of Sciences, San Francisco, the Snow Entomological Museum of the University of Kansas, Lawrence, Oregon State College at Corvallis, G. E. Bohart, Logan, Utah, the American Museum of Natural History, New York City, Cornell University at Ithaca, New York, J. G. Rozen at Ohio State College, Columbus, and in the author's collection.

*Distribution.* *M. hurdi* is known only from California (Fig. 28). In addition to the type material, 13 females and 2 males have been examined from the localities listed below (including the type locality).

CALIFORNIA: Antioch; Oakley; Rio Vista; Turlock.

*Flower Records.* *Artemisia* sp., *Centromadia pungens*, *Eriogonum* sp., *Grindelia* sp., *G. camporum*, *Gutierrezia californica*, *Lessingia glandulifera*, *Solidago* sp.

### *Melissodes (Eumelissodes) pallidisignata* Cockerell

*Melissodes nigrosignata pallidisignata* Cockerell, 1905, Proc. Biol. Soc. Washington, vol. 18, p. 180.

*Melissodes menuacha vernoneusis* Viereck, 1905, Canadian Ent., vol. 37, p. 320 (new synonymy); Cockerell, 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 77, 78; Cresson, 1928, Mem. Amer. Ent. Soc., vol. 5, p. 71.

*Melissodes praelauta* Cockerell, 1905, Psyche, vol. 12, p. 102 (new synonymy); 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 75, 76; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 137.

*Melissodes pallidisignata* is a highly variable species not closely related to any of the foregoing species. The females of *pallidisignata*

superficially resemble those of *menuachus*, *semilupina* and related species, but can be separated from these by the presence of dark brown hairs on the mesoscutum and scutellum. In the palest females only a few to several dark hairs occur medially on the scutellum, but usually they are abundant on the mesoscutum as well, and in the darkest females most thoracic hairs are black. The males of *pallidisignata* can be separated from those of *menuachus* and related species by the relatively short antennae. The antennae of *pallidisignata* do not reach the prestigma in repose and the penultimate flagellar segment is always considerably shorter than three times its least diameter. In addition, the apices of the terga of the males are often infumate, varying from colorless to dark reddish brown, and dark hairs are often present on the scutellum and mesoscutum.

*Female.* Measurements and ratios: N, 20; length, 10-16 mm.; width, 3.5-5.0 mm.; wing length,  $M = 3.84 \pm 0.269$  mm.; hooks in hamulus,  $M = 14.85 \pm 0.182$ ; flagellar segment 1/segment 2,  $M = 2.02 \pm 0.024$ .

Structure and color: Integument black except as follows: apical half of mandible, lower surface of flagellar segments 3-10, distitarsi, and in pale forms apical halves of terga rufescent; eyes gray to grayish blue; wing membrane colorless, veins black to reddish brown (palest in eastern populations); tegulae dark reddish brown to black; tibial spurs pale yellow to pale brown.

Structure and sculpturing as in *agilis* except as follows: clypeus relatively flat, oculoclypeal distance equals less than two-thirds minimum first flagellar diameter, punctures round, irregular in size, separated by half to one puncture widths, surface moderately shiny to dull, with coarse shagreening relatively sparse to dense, supra-clypeal area shiny to opaque and dulled by dense reticular shagreening; vertex with lateral flat areas moderately shiny, with small irregular punctures and usually slightly shagreened; galeae above shiny except at tips to completely dulled by dense, coarse tessellation; maxillary palpal segments in ratio of about 8:6:4:1, last two segments often longer, but third never longer than second. Mesoscutum with punctures on anterior third well separated, often by as much as one puncture width or more, posteromedian area often largely impunctate, when present punctures larger than anteriorly and separated by one to three puncture widths; scutellum punctures deep, round, mostly smaller than posterior mesoscutal and separated by one-half to two puncture widths; mesepisternal punctures shallow, often indistinct posterior borders, mostly as large as largest

mesoscutal, surface shiny and unshagreened to slightly and delicately so. Tergum 1 with basal three-fifths or less medially with punctures small, shallow, separated mostly by one puncture width or less, often with indistinct posterior margins, apical area impunctate, with large, oval, impunctate lateral areas extending anteriorly, surface dulled in punctate area by coarse, dense, reticulotransverse shagreening, an impunctate area shiny and shagreening extremely fine; tergum 2 with basal area punctures round, small, separated mostly by one puncture width, surface shiny, apical area impunctate and shagreening extremely fine, interband zone with scattered, irregular punctures, with lateral raised area punctures separated mostly by three puncture widths or more, surface shiny with sparse shagreening to dulled by dense, coarse, reticulotransverse shagreening; interband zone in addition to ordinary small punctures with large punctures having raised anterior rims giving rise to erect bristlelike hairs, these punctures also in apical part of basal area (other species have such punctures, but usually less conspicuous than in *pallidesignata* and usually not extending into basal area); tergum 3 similar but interband zone punctures more abundant; pygidial plate V-shaped with rounded apex.

Hair: Vestiture highly variable; palest specimens as in *ochraea* except as follows: scutellum with dark brown hairs; mesoscutum usually with posteromedian patch of dark hairs as large to twice as large as scutellar dark patch and often with pale hairs mixed with the dark anteriorly; vertex of head usually with several to many dark hairs; pale thoracic and head hairs usually pale ochraceous to white; tergum 2 with pale distal band notched medially along posterior border, not reaching apex of tergum at extreme sides except occasionally, interband zone hairs usually all pale, interband zone with long, bristlelike, erect hairs; tergum 3 similar to 2 but pale distal band often reaching apex laterally (rarely across lateral third or more), basal area with dark brown tomentum; tergum 4 with broad white apical pubescent band; terga 5 and 6 usually with pale lateral tufts; sternal hairs reddish brown except apically on sternum 5. Leg hairs pale ochraceous except as follows: inner surface hind and middle basitarsi, basitibial plate, fore basitarsus, and usually distitarsi dark brown; fore and middle tibiae often with outer apical surfaces pale brown. Considerable melanism occurs in various populations of *M. pallidesignata* and these melanistic specimens are described below under the topic of geographical variation.

*Male.* Measurements and ratios: N, 20; length 8-13 mm.; width, 2.5-4.0 mm.; wing length,  $M = 3.51 \pm 0.262$  mm.; hooks in hamulus,



$M = 13.00 \pm 0.178$ ; flagellar segment 2/segment 1,  $M = 3.19 \pm 0.089$ .

Structure and color: Integument black except as follows: clypeus yellow; labrum with small to large mediobasal pale spot; mandible with base black, with large triangular spot, or with small round pale spot; eyes green to bluish gray; flagellum yellow to red beneath (except first segment), reddish brown to black above; wing membrane colorless, veins red to dark brown, tegulae piceous; distitarsi rufescent; tibial spurs colorless to yellow; tergal apices colorless to dark reddish brown.

Clypeus relatively flat (as in *menuachus*); first flagellar segment minimum length about one-fourth to one-third maximum length second segment, often longer, penultimate segment more than one-third as broad as long (usually about two-fifths), flagellum in repose not reaching prestigma; maxillary palpal segments in ratio of about 3.5:2.5:2.5:1.0. Sculpturing as in female except as follows: clypeal punctures shallow; tergum 1 with basal four-fifths punctate, punctures often separated by more than one puncture width; interband zones of terga 2-4 usually more distinctly punctured and usually shinier than in female; sterna with surfaces shiny to dull, often with dense, coarse, reticular shagreening. Terminalia as in *rustica* described on following pages (Figs. 96-98).

Hair: Vestiture as in *menuachus* except as follows: scutellum often with a few to many dark hairs medially; mesoscutum frequently (especially in western populations) with abundant dark brown hairs on mesoscutum; dorsal thoracic hairs not usually appressed, long and loosely erect or short and erect; tegulae and vertex of head rarely with brown hairs. Metasomal terga 2-5 in dark specimens often with basal tomentum brown (not dark chocolate brown, but relatively pale brown as in milk-chocolate).

*Geographical Variation.* *Melissodes pallidesignata* is highly variable in several characters involving both sexes. This variation is at least partly geographic, and it would be possible to recognize from two to six (and possibly more) subspecies, depending upon which set of characters and upon which statistical criteria are used. In the present work subspecies are not recognized for reasons given below following the detailed account of the distribution of certain of the variable characters. First of all, both sexes are highly variable in regard to color of the vestiture. I shall discuss females first with regard to this and other characters. From the eastern border of the species range (see map, Fig. 24) west to central and southern California, central Oregon, Idaho, and southern British Columbia the

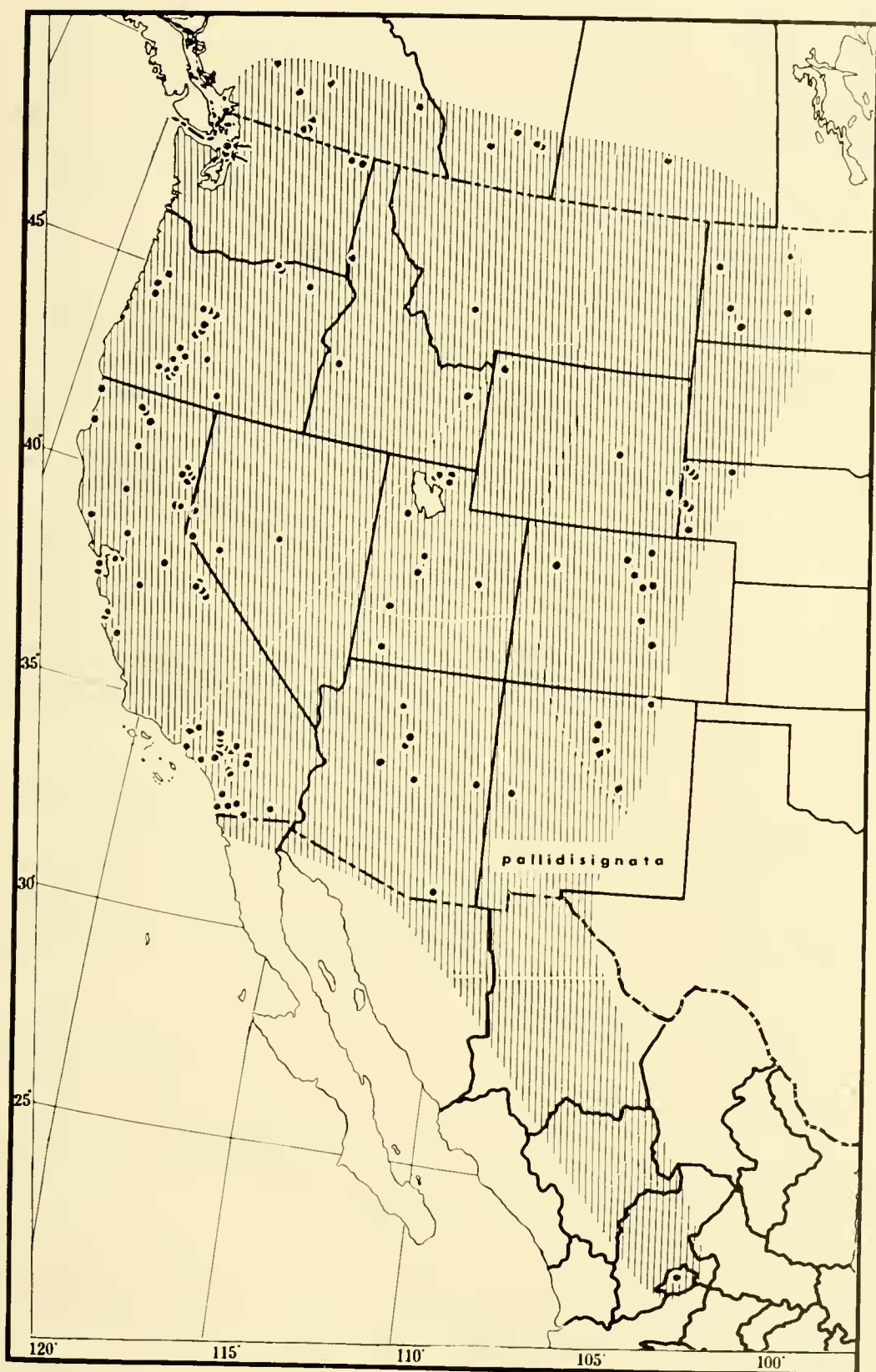


FIG. 24. Map showing the known distribution of *M. (Eumelissodes) pallidesignata* Cockerell.

females have a typically pale pattern with some local variations. In these females, the head hairs are usually all pale except brown on the vertex. The thoracic hairs are pale except medially on the scutellum and posteromedially on the mesoscutum where they are brown to black. The metasomal terga have pale pubescent bands as described in the formal description given above without any tendencies towards melanism.

In the populations of southern California (San Bernardino, Riverside, San Diego, and Mono counties) females show a strong tendency toward melanism of the vestiture of the mesoscutum and scutellum without showing any tendencies towards darkening of the metasomal, head or lateral thoracic hairs. This involves, especially, a progressive enlarging of the dark brown mesoscutal patch until in the darkest females this patch covers all of the mesoscutum except the extremely narrow anterior margin. The darkest females also have dark brown hairs on the posterior pronotal lobes. About 70-80% of the females from this area exhibit melanism of this type. This tendency occurs to a less marked degree in specimens from the inter-montane region (especially Utah) and in eastern Colorado and western Nebraska. In central and northeastern California, Idaho, British Columbia and Alberta this tendency is not evident.

The females from populations along the coast of California (north of northern Monterey County) in and west of the Coastal Range Mountains, north to Whidby Island, Washington and broadening eastward to include part of Siskiyou County in northern California, the western half of Oregon (especially the Crater Lake-Klamath Marsh area), and the Metaline Falls region of northeastern Washington exhibit a more extreme melanism. In these the mesepisternal hairs tend to become dark progressively from the ventral and anterior surfaces until in the darkest specimens the lateral surfaces of the thorax are entirely dark. The head hairs also are more melanistic than in the eastern form and, in the darkest, are entirely dark brown to black. The dorsum of the thorax, on the other hand, usually tends to remain as in the average eastern female with the mesoscutal dark patch remaining slightly larger than the scutellar dark patch and extending in area only in the darkest individuals. This is not so true, however, of the Metaline Falls, Washington population in which the mesoscutal patch enlarges concurrently with the darkening of the sides of the thorax and head. The metasomal terga also show melanism. Terga 5



and 6 lack pale lateral tufts in all but the palest females from this region. Tergum 4 tends to have the pale apical pubescent band partly or wholly dark brown. The pale distal bands of terga 2 and 3 tend to be dark medially. The long pale basal hairs of tergum 1 tend to be partly dark. The darkest of the females are from the Crater Lake-Klamath Marsh area of Oregon, the Metaline Falls area of Washington, and Mendocino, San Mateo and Monterey counties of California.

Using this set of female characters, three subspecies could be recognized, each occupying the ranges outlined in the preceding paragraphs. It should be emphasized here that the dark Southern California females differ from the dark coastal females not only in intensity of melanism, but also in the pattern of melanism. It is this sort of difference (that is, pattern rather than degree) which the author has used to help in distinguishing species in this genus and, furthermore, some melanism patterns are typical of certain subgenera.

Along with the melanism pattern described above, there is variation in the length of the hair, particularly of the head and thorax. The eastern form usually has short hairs which on the dorsum of the thorax has a peculiar clipped appearance when viewed under a stereoscope. The dark coastal females have exceedingly long, loose hairs, not at all appearing clipped on the thorax. However, the Crater Lake-Klamath Marsh area of Oregon, where some of the darkest females occur, has females with hairs of short to medium length and usually with clipped appearance. The females from the Metaline Falls area of Washington have very short, clipped hairs. These last are also among the darkest of the females.

Pale females in a long series from Antioch and Oakley (Contra Costa County) and Turlock (Stanislaus County) in California have the hair short to medium (medium especially in the Antioch females) in length. These populations are very near in space to populations of typical long-haired, dark females in San Mateo and Monterey Counties, so that some intermediates in hair length might be expected to occur here. Intermediates in hair color ought also to occur in the Antioch-Turlock area and some do. In this area females lack the tendency towards enlargement of the mesoscutal dark patch beyond the average size of this patch of the eastern populations. Also, a small number of females from Antioch have a few to several brown hairs on the ventral surfaces of the mesepisterna and lack pale lateral tufts on terga 6 and 7. However, the Antioch-Tur-

lock populations also include the palest females known in this species (especially in the series from Turlock). In these pale individuals the mesoscutal hairs are entirely pale ochraceous and only a few to several dark brown hairs are present on the scutellum. It seems as if very little migration and gene flow occurs across the southern San Francisco Bay area and across the Coastal Range Mountains in this area, or the selective forces operating in the two areas are especially effective. Also, there seems to be rather limited gene flow between the Antioch-Turlock populations and the southern California populations, but there is a large gap in central California from which no specimens are available.

Populations of the Metaline Falls region of northeastern Washington are also peculiar in that the females average dark in color (although less so than in the Crater Lake-Klamath Marsh area of Oregon) and have exceedingly short, clipped hairs on the thorax. This population includes some of the darkest females known. Also, the tendency towards expansion of the mesoscutal dark patch occurs here even in relatively pale females, much as in southern California. Furthermore, females in these populations tend to have the mesoscutal hairs (especially anterior to the dark patch) pale rufescent rather than pale ochraceous or white. This is similar to the related, more eastern species, *Melissodes rustica* (Say). A fourth subspecies could possibly be recognized in this area using the combination of characters outlined in this paragraph.

Southern British Columbia females are similar to those of the Antioch-Turlock area in that there is some darkening of the ventral mesepisternal hair. Otherwise these females are typical of the more eastern populations in color and hair form.

In addition to these characters, the sculpturing of the galeae and of the metasomal terga (base of tergum 1 and interband zones of terga 2 and 3) is variable. The distribution of these characters follows that of hair color to some extent, but there is more intrapopulation variation and certain exceptional areas where the correspondence between hair color and sculpturing does not hold. In general the pale populations have shiny, unshagreened (except at tips) galeae and shiny, finely shagreened interband zones of tergum 2, whereas the darker populations have densely shagreened, opaque galeae (or at least the apical half or more of the galeae are shagreened) and densely shagreened, dulled interband zone of tergum 2.

Females of the populations of southern California and eastern California east of the southern Sierra Nevada Mountains consistently

have the shiniest galeae and terga. Females from the Turlock area are similar. From the Antioch area, however, the females appear intermediate in this respect, about 50% having dull and 50% having shiny galeae and second terga. From nearby San Mateo and Monterey counties the females have dull galeae and terga. In Oregon, the females, whether pale or dark, are a mixture similar to that of the Antioch area in regard to sculpturing, but tend more towards greater shagreening of both galeae and second terga. The dark females from the Metaline Falls area of Washington consistently have densely shagreened galeae and second terga. Females from southern British Columbia are somewhat intermediate, but show a high degree of shagreening (70% or more dulled). The females of the populations to the east of these areas generally are intermediate in sculpturing of the galeae and terga, but more often have shiny galeae and dulled second terga than otherwise.

The size of the individuals (both male and female) is also variable. However, for the most part there seems to be no consistent geographical pattern in size variation. In general this is a medium-sized to large bee. The populations from the desert areas of southern California (excluding Los Angeles and Kern counties) appear to have consistently smaller individuals than elsewhere in the range. Also, specimens from the Crater Lake-Klamath Marsh area of Oregon seem to average smaller than normal, but not as small as the southern California specimens.

From the foregoing, which is based on female characters alone (except for size variation), four or five more or less well-marked subspecies can be recognized. The first consists of dark, long-haired females with dulled galeae and second terga occupying the coastal region of California north of Monterey County, Oregon and Washington (and perhaps southern British Columbia). The second consists of populations of southern California north to Los Angeles in the west and Mono County in the east in which females are small, short-haired, have shiny galeae and second terga and tend to have the mesoscutal dark patch much enlarged. The third consists of dark females with dark mesoscutal hairs, dulled galeae and second terga, somewhat rufescent mesoscutal pale hairs, and short hair occupying the Metaline Falls region of northeastern Washington. The rest of the range of the species in central and eastern California, eastern Oregon, Southern British Columbia, and states and provinces to the east is occupied by the fourth form in which females are short-haired, of medium melanism, and usually with shiny



galeae and second terga. The last would be a poorly marked subspecies, as in each characteristic it falls somewhat in between two or more of the other subspecies. A fifth form might also be recognized occupying the central valley (Turlock) area of California, as females from this area are consistently paler than from elsewhere in the range of the species.

The males have a few characteristics which vary geographically and which do not apply to the females. The first of these concerns mandibular color. The base of the mandible is either black, has a small round yellow spot, or has a large triangular yellow macula. These three states can be considered as two extremes and the intermediate condition of one character. Males from Alberta, Saskatchewan, North Dakota, eastern Wyoming, Nebraska, Colorado, Utah, Arizona and New Mexico usually have mandibles with large yellow maculae at their bases. Occasional specimens (5% or less) have small round yellow spots. None from this area has black mandibular bases. Populations from Utah bear the highest proportion of males with small round mandibular yellow spots (3 out of only 10 males known from Utah) and seem to be intermediate populations in this respect, but the samples are small. To the west of this area males usually have the base of the mandible black, but rare individuals with the intermediate condition occur in almost every population from which reasonable sized samples are available. For instance, from Oregon 115 males were examined and seven had the intermediate condition (slightly less than 6%), the remaining 108 had black mandibular bases. Nine males were available from northwestern Wyoming (Yellowstone National Park) and of these two had small mandibular spots, the remaining seven black mandibular bases. This population could be also considered as intermediate, although the sample is small. Consideration of this male character splits the eastern populations (fourth subspecies of the preceding paragraph) almost equally into two large areas and a fifth (or sixth) subspecies could be thus recognized in the eastern-most and southeastern parts of the species range. This subspecies would be characterized primarily by the males having large, yellow, triangular maculae on the mandibular bases.

Another male characteristic which varies a good deal is the integumental color of the apices of the terga. This varies from colorless through yellow and pale brown to brown or dark brown. Specimens from the same populations in which males have large triangular yellow mandibular maculae usually have colorless or yellow

tergal apices. To the west the males usually have pale to dark brown tergal apices, with considerable intrapopulational variation. However, the central California populations from Riverside to Antioch have almost all males with colorless or yellow terga, so this character could be used in conjunction with the pale color of the females to delimit a subspecies. However, the distribution of this character, especially in central California, does not follow the distribution of other characters very closely. Except for this character, the Riverside population falls within the southern California desert form. Likewise, the Antioch area does not seem to be transitional to the dark coastal form in this character as it is in certain female characters discussed above.

As to size and sculpturing, what has been said concerning the females applies generally to the males. However, the males appear to have considerably more intrapopulational variation with respect to these characteristics and they would scarcely be useful in delimiting subspecies. This is also true of hair color. Males in general are much paler than the females from the same area and there is a large amount of intrapopulational variation among males in regard to hair color. It is interesting to note, however, that the darkest males are from the Crater Lake-Klamath Marsh area of Oregon and the males from this area average darker than from the coastal area of California, Oregon and Washington. The hair length, particularly of the head and thorax, of the males is distributed about as it is in the females.

It is evident from the foregoing, sketchy as the data may be, that first, there are a number of characters varying in a clinal fashion. Second, the clines of these characters are correlated with one another in some areas but not in others. Third, characters not clinally distributed are also present. Fourth, no one of the eight characters discussed (3 female and 5 male) is distributed precisely like any one other with the same breaks in distribution, whether clinal in nature or not (the only possible exception to this occurs between characters which apply to both females and males, such as sculpturing or hair length). Some characters may coincide with others in being limited by the same boundary in some parts of the range (hair color and hair length in females coincide in the San Mateo-Monterey area and the Antioch-Turlock area of California) but not in other areas (hair color and hair length do not coincide in distribution in Oregon and Washington). In the foregoing I have tried to distinguish between the correlation in direction of clinal

characters and the coincidence of the break in the distribution of characters.

Although combinations of characters could be used to classify these sampled populations, it seems evident to the writer that to do so would be to represent the facts in an artificial manner and, indeed, would tend to obscure the actual distribution of the characters which is exceedingly complicated. An arbitrary decision would first have to be arrived at as to which characters to use and which to ignore. Another arbitrary decision would have to be made as to what percent of which sex must be identifiable in order to limit the range of each race. Also, some subspecies would be characterized by female and others by male characters alone, or characters pertaining to one or the other sex would have to be ignored.

If six subspecies were recognized using all characters studied, many of the populations from which samples are available would be classified as intermediate populations between two or more subspecies. This would be an error in the light of the facts of the distribution of the characters. The so-called intermediate populations are, in fact, simply populations exhibiting combinations of characters differing from the nearby populations classified as subspecies. Yet the populations classified as subspecies and not intermediates are distinctive for the very same reason. That is, they possess a peculiar combination of characters. Both types of populations have these distinctive combinations because of the character clines and/or the distributions of characters not being well-correlated or not coinciding in area. Which populations represent subspecies proper and which represent intermediates or intergrades then depends upon the viewpoint of the observer. That is, it depends upon which characters he selects as being important in delimiting and classifying the geographical races. The facts indicate that almost every geographic area from which a large enough sample is available is occupied by a population made distinctive by a peculiar combination of characters.

In view of this situation the author regards the recognition of subspecies as being superfluous or even scientifically in error. In cases where only one or two characters in a species are known to vary geographically, it may be desirable from a pragmatic point of view to recognize two or more subspecies. Also, if many characters are varying, it may be possible to recognize races by using some of the more subtle multivariate statistical procedures. However, the author knows of no good example of such an analysis in entomo-



logical work, and the results obtained thereby would be subject to the same objections reviewed in the preceding paragraphs.

A statistical or graphical representation of the facts in *M. pallidesignata* was not prepared for the reason that, although several hundred specimens were available for study, they were not distributed in such a manner as to provide good samples from most areas. For instance, out of approximately 700 specimens available, over 400 were from six localities or limited areas, with less than 300 distributed unevenly over the remaining range of the species. A statistical, and even a graphical, representation could have been very misleading.

*Bionomics.* Table XIII gives a summary of the available flower records from field collections for *M. pallidesignata*. These data indicate that *pallidesignata* is an oligolege of the family Compositae and depends primarily upon flowers of the genera *Isocoma*, *Chrysothamnus*, and *Grindelia* in that order of preference.

*Type Material.* Female holotype of *pallidesignata* Cockerell collected by F. H. Snow in August at Oak Creek Canyon, Arizona, is in the Snow Entomological Museum of the University of Kansas, Lawrence. Female holotype and male allotype of *vernonensis*

TABLE XIII. Summary of Floral Records for *Melissodes pallidesignata*.

Plant Data			Records of <i>M. pallidesignata</i>			
FAMILY	Number of genera	Approximate number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae:						
<i>Isocoma</i> spp.	1	2	30	42	26	68
<i>Chrysothamnus</i> spp.	1	2	17	33	27	60
<i>Grindelia</i> spp.	1	3	15	18	33	51
<i>Solidago</i> spp.	1	3	12	6	51	57
<i>Gutierrezia</i> spp.	1	2	7	6	10	16
Other genera	15	17	32	26	19	45
Other families (2)	6	6	18	13	23	36
Totals	26	35	131	144	189	333

Viereck from Vernon, British Columbia, August 17, 1904, are in the collection of the Philadelphia Academy of Sciences. Male holotype of *praelauta* Cockerell collected by F. H. Snow in July at Oak Creek Canyon, Arizona, is in the Snow Entomological Museum (this male unlike other Arizona males examined by the author, has black mandibular bases, otherwise it is like the pale New Mexico, Colorado, Arizona and Nebraska males).

*Distribution.* From southern California to southern British Columbia in the west, to southern Saskatchewan, western North Dakota and Nebraska, eastern Colorado and New Mexico in the east (Fig. 24). A single female from the state of Agauscalientes in Mexico is assigned to this species and the range presumably extends that far south, although no other specimens have been seen from Mexico. This species has been collected from June 10 to October 27, but chiefly in August. In addition to the type specimens, 333 females and 523 males have been examined from the localities listed below (including localities reported in the literature).

ARIZONA: Apache Co.; East Verde River; Flagstaff; Grand Canyon (South Rim); Huachuca Mts.; Oak Creek Canyon; Prescott. CALIFORNIA: Anaheim; Antioch; Arcata, Humboldt Co.; Artois; Bridge Creek Camp, Lassen Co.; Cloverdale; Convict Lake, Mono Co.; Crescent City; Davis; Elk Creek, Siskiyou Co.; Erwin Lake, San Bernardino Co.; Grant Lake, Mono Co.; Greenfield (8 miles W.); Helendale; Hemet Valley, San Jacinto Mts.; Imperial Co.; Inglenook Swamp, Mendocino Co.; Jacumba; Mt. Laguna; Lancaster; Litchfield; Los Angeles; Los Angeles Co.; Mammoth; McCloud; Milford; Millbrae; Mission Valley; Mono Lake, Mono Co.; Morongo Valley; Moss Beach, San Mateo Co.; Naples; Oakley; Old Shasta; Oro Grande; Pacific Grove; Pine Knot, Bear Lake, San Bernardino Co.; Pine Meadow, San Jacinto Mts.; Pinos, Monterey Co.; Redlands; Riverside; San Diego; San Diego Co.; San Felipe Creek, S. Diego Co.; Sierraville; Sisson, Siskiyou Co.; Standish (and 4 miles W.); Tesla; Turlock; Upper Santa Ana River, S. Bernardino Co.; Vallecito; Victorville; Whitewater; Yuba Pass, Sierra Co. COLORADO: Berkeley; Boulder; Boxelder Creek (E. of Aurora); Colorado Springs (Fountain Valley School); Denver; Eaton; Estes Park; Meeker; Medicine Bow; Pueblo. IDAHO: Emmett (10 miles E. at Squaw Creek); Lewiston; Rexburg. MONTANA: Whitehall. NEBRASKA: Gering; Glen, Sioux Co.; Gordon; Kimball; Mitchell; Monroe Canyon, Sioux Co.; War Bonnet Canyon, Sioux Co. NEVADA: Austin; Minden; Reno; Walker Lake. NEW MEXICO: Embudo (6 miles N. E.); Omega; Raton; Rowe; Santa Fe (and 12 miles S. E.);

Vaughn. NORTH DAKOTA: Bismarck; Denbigh, McHenry Co.; Dickinson; Mott; Schafer; Steele. OREGON: Bend (20 miles S. and at Sandy River S. of); Chemult; Crater-Diamond Lake Road Junction, Klamath Co.; Crater Lake Park (East Entrance; Lost Creek; near Headquarters; Pole Bridge Meadows; 8 miles out on Medford road); Corvallis; Echo; Fort Klamath (and 5 miles N.); Klamath Falls (54 miles E. and 59 miles N.); Klamath Marsh; LaGrande (5 miles N.); Lapine; Prineville (10 miles W.); Salem-Albany road; Silver Lake; Sisters (and 14 miles E.); Umatilla; Willamette River. UTAH: Bert; Cande; Delta; Emery Co.; Jericho; Milford; Petersboro; Promontory; Thatcher; The Dalles; Zion Park. WASHINGTON: Coupeville (Whidby Island); Metaline Falls; Northport; Whidby Island. WYOMING: Casper (E. at 10 mile draw); Lingle; Yellowstone National Park. Canada. ALBERTA: Lethbridge; Medicine Hat; Redcliffe; Scandia. BRITISH COLUMBIA: Invermere; Lillooet; Nicola; Oliver; Penticton; Similkameen (towards Okanagan); Vernon; Wallhackin. SASKATCHEWAN: Caron. México. AGUASCALIENTES: Rincon de Romos (12 km. N.).

*Flower Records.* *Aplopappus* sp., *A. gracilis*, *Aster* sp., *A. adscendus delectabilis*, *Centromadia pungens*, *Chrysopsis hispida*, *Chrysothamnus* sp., *C. nauseosus*, *C. n. mojavensis*, *C. n. occidentalis*, *C. n. viscidiflorus*, *Cirsium* sp., *Cleome* sp., *C. serrulata*, *Ericameria palmeri*, *Grindelia* sp., *G. camporum*, *G. platyphylla*, *G. squarrosa*, *Gutierrezia californica*, *G. sarothrae*, *Helianthus* sp., *Heliotropium* sp., *Hemizonia* sp., *Heterotheca grandiflorum*, *Isocoma acradenia*, *I. vernoniodes*, *Lepachys* sp., *Lessingia glandifera*, *Medicago sativa*, *Melilotus* sp., *M. alba*, *Petalostemum* sp., *P. occidentalis*, *Pluchea persica*, *Psilostrophe gnaphalodes*, *Senecio ionophyllus*, *Solidago* sp., *S. canadensis*, *Wislizenia refracta*.

*Melissodes (Eumelissodes) rustica* (Say)

- Macrocera rustica* Say, 1837, Boston Jour. Nat. Hist., vol. 1, p. 406; LeConte, 1859, Entom. Writ. Th. Say, vol. 2, p. 781.  
*Melissodes rustica*, Smith, 1854, Cat. Hymen. Brit. Mus., vol. 2, p. 309; Cresson, 1879, Trans. Amer. Ent. Soc., vol. 7, p. 225; Patton, 1879, Bull. U. S. Geol. Surv., vol. 5, p. 472; Provancher, 1888, Addit. Pet. Faun. Canada, Hymen., vol. 2, p. 300; Evans, 1896, Can. Ent., vol. 28, p. 13; Birkman, 1899, Ent. News, vol. 14, p. 245; Bridwell, 1899, Trans. Kansas Acad. Sci., vol. 16, p. 211; Viereck, 1903, Ent. News, vol. 14, p. 119; Smith, 1910, Ann. Rep. New Jersey State Mus., 1909, p. 693; Graenicher, 1911, Bull. Pub. Mus. Milwaukee, vol. 1, p. 247; Viereck, 1916, Bull. Connecticut Geol. Nat. Hist. Surv., vol. 22, p. 732; Graenicher, 1935, Ann. Ent. Soc. Amer., vol. 28, p. 304; Proctor, 1938, Biol. Surv. Mt. Desert Region, vol. 6, p. 444; Brimley, 1938, Insects of North Carolina, p. 463.  
*Melissodes assimilis* Smith, 1879, Deser. of new species of Hymen. in the collection of the British Museum, p. 114 (new synonymy).



- Melissodes ambigua* Smith, 1879, Descr. of new species of Hymen. in the collection of the British Museum, p. 116 (new synonymy).  
*Melissodes festinata* Provancher, 1888, Addit. Pet. Faun. Canada, Hymen., vol. 2, p. 300 (new synonymy).  
*Melissodes simillima* Robertson, 1897, Trans. Acad. Sci. St. Louis, vol. 7, p. 355; 1905, Trans. Amer. Ent. Soc., vol. 31, p. 368; Cockerell, 1906, Trans. Amer. Ent. Soc., vol. 32, p. 113; Lovell and Cockerell, 1906, Psyche, vol. 13, p. 111; Robertson, 1918, Ent. News, vol. 25, p. 70; Viereck, 1916, Bull. Connecticut Geol. Nat. Hist. Surv., vol. 22, p. 732; Pearson, 1933, Ecol. Monogr., vol. 3, p. 381; Robertson, 1926, Ecology, vol. 7, p. 380; 1928, Flowers and Insects, p. 8; Brimley, 1938, Insects of North Carolina, p. 463.  
*Melissodes asteris* Robertson, 1914, Ent. News, vol. 25, p. 70 (new synonymy); 1914, Ent. News, vol. 25, p. 373; 1926, Ecology, vol. 7, p. 379; 1928, Flowers and Insects, p. 8; Michener, 1947, Amer. Mid. Nat., vol. 38, p. 454.

*Melissodes rustica* is a small, highly variable species closely allied to *M. pallidisignata* Cockerell. It differs from the latter chiefly in its smaller size and generally darker color. Females of *rustica* are difficult to distinguish from those of *pallidisignata* because of the large amount of color variation exhibited in both species. Females of *rustica* can be characterized as follows: mesoscutum always with brown patch of hairs at least as large as scutellar dark patch; mesepisterna usually with dark hairs at least below; tergum 2 with punctures not of two conspicuously different sizes as in *pallidisignata*; scopal hairs usually yellow; apical areas of terga 1-3 impunctate, shiny, apubescent or almost so and distal pale pubescent bands of terga 2 and 3 not reaching apices of terga at sides. The males of *rustica* differ from those of *pallidisignata* as follows: dark reddish brown tergal apices; mandibular bases black; labrum usually with pale mediobasal spot; first flagellar segment with minimum length one-sixth to one-fourth maximum length of second segment, flagellum reaching or surpassing pterostigma in repose. In addition, the male of *rustica* has the punctation of tergum 2 as in the female.

*Female.* Measurements and ratios: N, 20; length, 10.0-14.5 mm.; width, 3.0-4.5 mm.; wing length  $M = 3.37 \pm 0.126$  mm.; hooks in hamulus,  $M = 12.55 \pm 0.256$ ; flagellar segment 1/segment 2,  $M = 1.91 \pm 0.024$ .

Structure and color: Integument black except as follows: apical half of mandible, lower surface flagellar segments 3-10, and usually distitarsi rufescent; terga 1-3 with apical areas dark reddish brown to black; eyes gray to greenish blue; wing membranes slightly infumate, veins dark brown to black; tegulae piceous; tibial spurs white to yellow, occasionally brown along serrated margins.

Structure and sculpturing as in *pallidisignata* with the following differences: clypeus with punctures usually more crowded and slightly larger, surface shagreening coarse, dense, dulling surface;

supraclypeal area usually dulled by sparse, shallow punctures and sparse, reticular shagreening; galeae usually dulled above in apical half or more; maxillary palpal segments in ratio of about 3.5:3.0:2.5:1.0, rarely with minute fifth segment present. Mesoscutum with punctures of anterior third crowded, mostly separated by half a puncture width or less, posteromedian area with punctures sparse, separated mostly by one to three puncture widths; scutellum with medial punctures separated by less than one to two puncture widths; mesepisternum with surface and bottoms of shallow punctures usually dulled by irregular, fine shagreening. Tergum 2 with basal area punctures small, round, separated by one to two puncture widths, surface dulled by fine reticular shagreening, interband zone punctures small, irregular, scattered, separated mostly by two to three puncture widths, surface dulled by coarse, reticular shagreening, without conspicuous large punctures at bases of bristlelike hairs, apical area impunctate, extremely shiny, with extremely fine reticulotransverse shagreening; tergum 3 similar to tergum 2 but basal area and interband punctures more crowded and apical area often with scattered minute punctures.

Hair: Vestiture highly variable; palest forms as follows: head white to ochraceous except brown on vertex; thorax white to ochraceous, often pale rufescent anteriorly on mesoscutum, scutellum with abundant dark brown and mesoscutal dark patch as large or larger than scutellar dark patch; metasomal tergum 1 with pale ochraceous hairs anteriorly, with ochraceous to yellow on basal three-fifths or more; tergum 2 with basal pubescence white to pale ochraceous, interband zone hairs suberect and mostly black, distal pale pubescent band ochraceous to yellow and usually narrowly interrupted medially, apical area often with sparse, short, subappressed hairs laterally near pale distal band; tergum 3 similar but basal tomentum thick, dark brown and distal band not interrupted, distal bands of terga 2 and 3 not reaching apices of terga laterally; tergum 4 with apical pale band uninterrupted medially, narrower than basal dark area; terga 5 and 6 often with small lateral pale tufts; sterna brown; legs pale ochraceous except as follows: scopae usually yellow, basitibial plate brown, fore and middle tarsi, outer surfaces fore and middle tibiae, inner surfaces hind basitarsi and tibiae and occasionally upper surface hind femora dark brown. In darkest females all hair dark brown to black except yellow scopal hairs and a few pale hairs at margins of posterior pronotal lobes, mesoscutum and wing bases. The variation is discussed in detail below in the section on geographical variation.

*Male.* Measurements and ratios: N, 20; length, 7.5-11.5 mm.; width, 2.0-3.0 mm.; wing length,  $M = 3.12 \pm 0.163$  mm.; hooks in hamulus  $M = 11.55 \pm 0.223$ ; flagellar segment 2/segment 1,  $M = 5.31 \pm 0.083$ .

Structure and color: Integument black except as follows: clypeus yellow with brown or rufescent apical margin; labrum with pale mediobasal spot; apical half of mandible and distitarsi rufescent, mandibles without basal yellow spots; terga with apical areas reddish brown; eyes yellowish green to bluish green or gray; wings, tegulae and tibial spurs as in female, but wing membranes often colorless and veins often reddish brown.

Structure as in *pallidisignata* except as follows: first flagellar segment minimum length one-fourth to one-sixth maximum length of second segment, penultimate segment one-third as broad as long or slightly shorter, in repose flagellum reaches pterostigma or slightly beyond; maxillary palpal segments in ratio of about 3.0:3.5:3.0:1.0, first segment occasionally almost as long as second and rarely minute fifth segment present. Sculpturing as in female except as follows: clypeal punctures shallow; galeae often unshagreened except in apical third; mesoscutum with posteromedian punctures usually sparser; tergum 1 with basal four-fifths with punctures separated by one-half to two puncture widths; tergum 2 with basal area punctures separated by one to three puncture widths, surface more finely shagreened; terga 3 and 4 with interband zone with coarse, reticular shagreening appearing almost like tessellation and completely dulling surfaces. Sternum 7 as in *agilis*. Sternum 8 as in *agilis* but apical hairs long and abundant, medioventral tubercle not bidentate, pointed. Genital capsule as in *agilis* but gonostyli with hairs sparse and short.

Hair: Vestiture as in *pallidisignata* and *menuachus* except as follows: pale hairs usually pale ochraceous to yellow; vertex of head usually with at least a few brown hairs; scutellum and mesoscutum often with brown hairs; tegulae often with brown hairs; tergum 2 with interband zone hairs suberect, partly or wholly dark brown; terga 3-5 with basal tomentum dark chocolate brown; terga 6 and 7 dark brown and usually without pale lateral tufts; tergum 5 often lacking pale distal band and tergum 4 with pale band often interrupted medially; sterna brown except laterally; legs pale ochraceous except as follows: middle and hind basitarsi yellow to reddish brown on inner surfaces, basitibial plates often pale brown.

*Geographical Variation.* The females of *rustica* are highly variable in regard to vestiture color. This variation is distributed



geographically. The males follow this variation in color, but are never as dark in color as the females and usually show much more intrapopulational variation. For this reason the following account is based upon the variation in females only.

The collections of the females of this species are abundant enough and so distributed as to make a graphical representation of the color variation feasible. Females were grouped geographically and classified into three states each of eight characters of vestiture color. The characteristics are listed below, each with the three states in the order of increasing melanism.

1. Tergum 4, distal pale pubescent band:
  - a. Without brown pubescence medially.
  - b. Brown pubescence apicomediaally to 50 percent brown.
  - c. More than 50 percent brown to entirely brown.
2. Tergum 3, distal pale pubescent band:
  - a. Not interrupted medially.
  - b. Interrupted medially up to one-third width of tergum.
  - c. Interrupted medially by one-third width of tergum to entirely dark brown.
3. Tergum 2, distal pale pubescent band:
  - a. Narrowly interrupted medially (less than one-fifth width of tergum).
  - b. Broadly interrupted medially (by one-fifth to one-half width of tergum).
  - c. Interrupted medially by one-half width of tergum to entirely dark brown.
4. Tergum 1, hairs of anterior surface:
  - a. Entirely pale.
  - b. From a few to 50 percent dark brown.
  - c. More than 50 percent to entirely dark brown.
5. Mesoscutal dark hair patch:
  - a. Not extending forward to a transverse line at anterior margins of tegulae; with abundant pale hairs mesad of tegulae; pronotal hairs pale.
  - b. Extending forward to or beyond a transverse line at anterior margins of tegulae; with few or no dark hairs mesad of tegulae; pronotal hairs all or mostly pale.
  - c. Extending forward almost or quite to pronotum medially; without pale hairs mesad of tegulae; pronotal hairs mostly or all dark.
6. Mesepisternal hairs:
  - a. All pale (except a few pale brown ventrally).
  - b. Brown on ventral and anterior surfaces and on lower lateral surface (less than 50 percent of lateral surface).
  - c. Dark brown on 50 percent or more of lateral surfaces.
7. Head hairs:
  - a. Pale except vertex with abundant dark hairs.
  - b. Vertex, labrum and clypeus with dark brown hairs, but clypeal hairs partly to almost entirely pale.
  - c. Vertex, labral and clypeal hairs entirely dark brown; other head hairs partly to entirely dark brown.

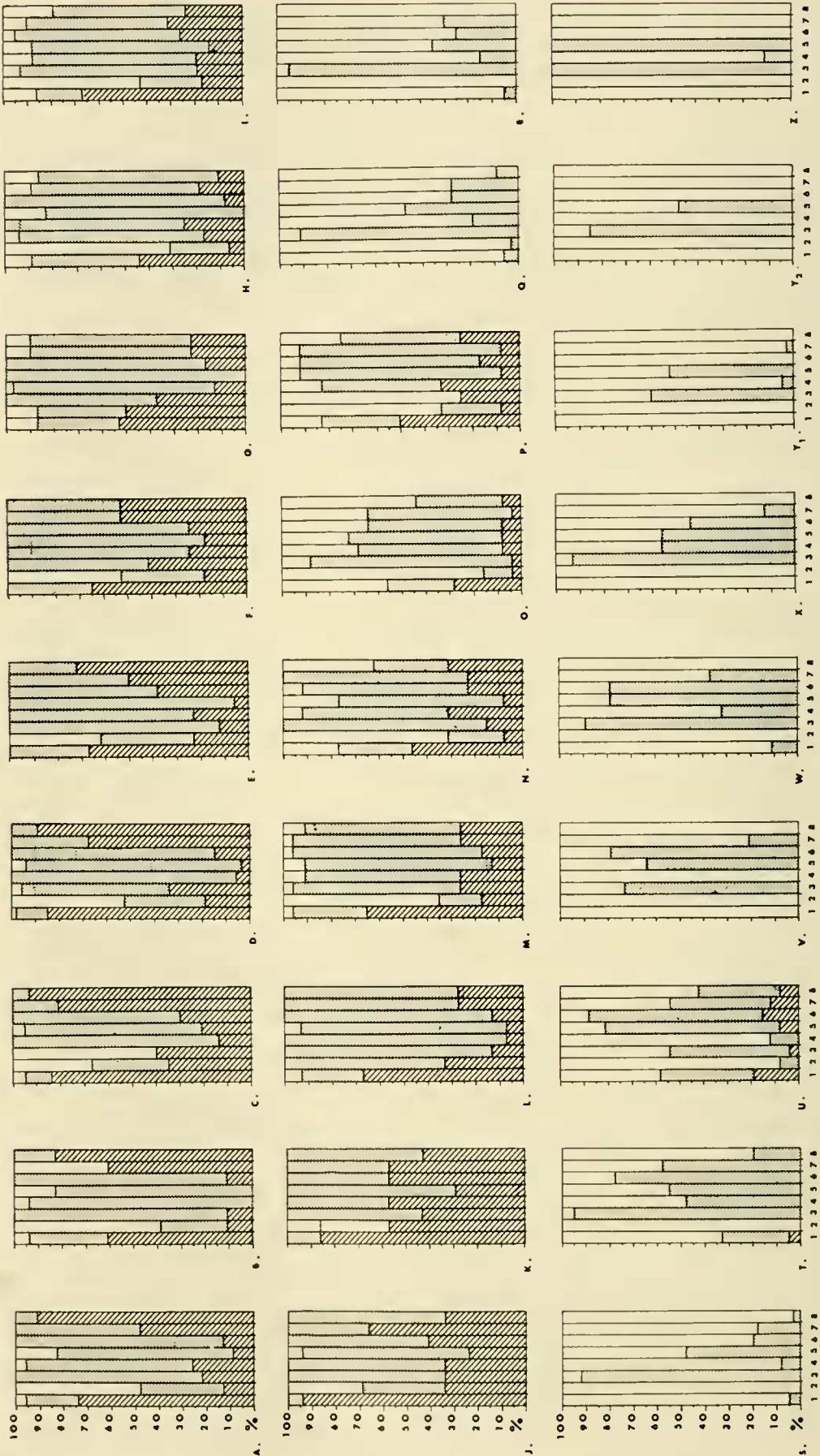


FIG. 25. Histograms showing the percentages of individuals (ordinates) of *M. (Eumelissodes) rustica* (Say) bearing certain characters (abscissas). Characters refer to females only. The derivation of the percentages and the characters is explained in the text.

## 8. Leg hairs:

- a. Coxae, trochanters, femora and outer surfaces of tibiae mostly pale.
- b. Tibiae, coxae, trochanters and inner surfaces of femora brown; outer surfaces of femora partly brown.
- c. All dark brown to black except scopae and occasionally anterior surfaces of femora.

After females from each of the geographical areas were classified according to the above characters, percentages of females exhibiting each state of each character for each geographical area were calculated and these percentages were used to prepare bar graphs (Fig. 25). The graphs are arranged roughly from North to South and from East to West. The numbers of females examined from each area are given below each graph together with the letter corresponding to the lettered list given below and to the lettered areas indicated on the distribution map (Fig. 27). A—New Brunswick, Nova Scotia, Maine; B—Vermont, New Hampshire; C—Massachusetts, Connecticut, Rhode Island; D—New York; E—New Jersey; F—Pennsylvania; G—Maryland, District of Columbia; H—Virginia; I—North Carolina; J—South Carolina, Georgia; K—Alabama, Mississippi, Louisiana; L—Quebec, Ontario; M—Ohio, Indiana, West

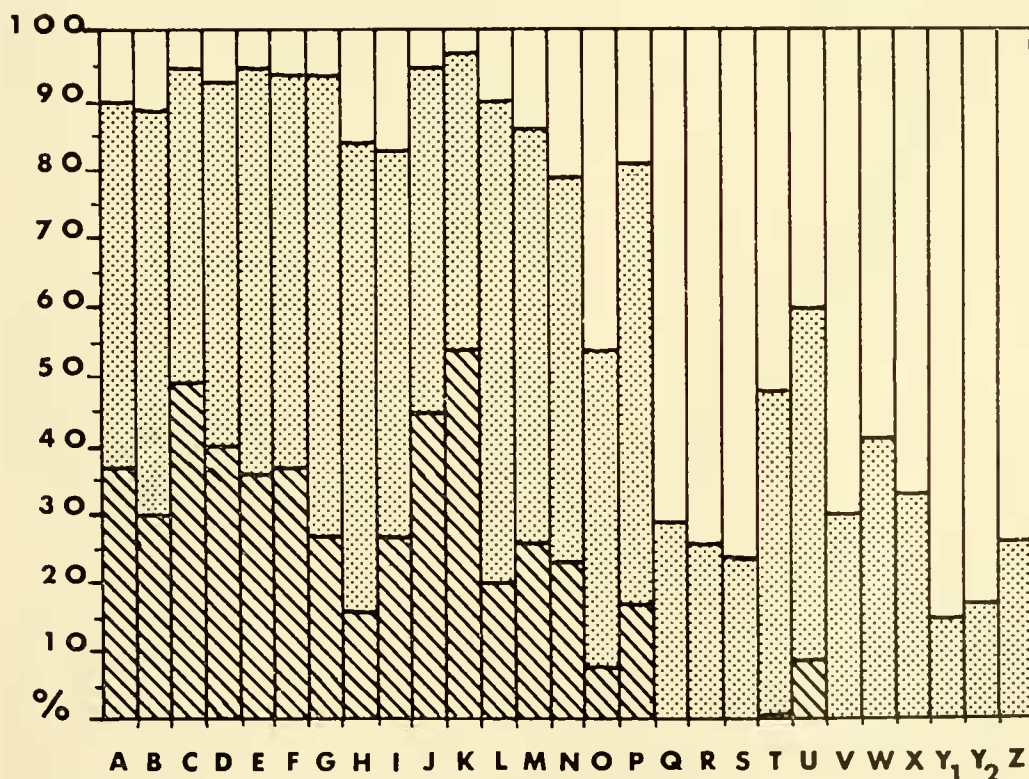


FIG. 26. Histogram for *M. (Eumelissodes) rustica* (Say) showing the average percentage (ordinate) for females within each of several localities (abscissa). The derivation of these percentages and location of the lettered localities is explained in the text.



Virginia; N—Wisconsin, Michigan; O—Illinois; P—Iowa, Missouri; Q—Minnesota; R—Manitoba; S—North Dakota; T—Nebraska (Lincoln); U—Kansas; V—Saskatchewan, Idaho, Montana, Wyoming; W—Colorado, New Mexico; X—Utah; Y1—Northern Arizona; Y2—Central Arizona; Z—Durango, Mexico. The three states of each of the eight characters were added together and averaged to obtain a melanism factor for each of the twenty-seven localities. These are illustrated in a bar graph (Fig. 26).

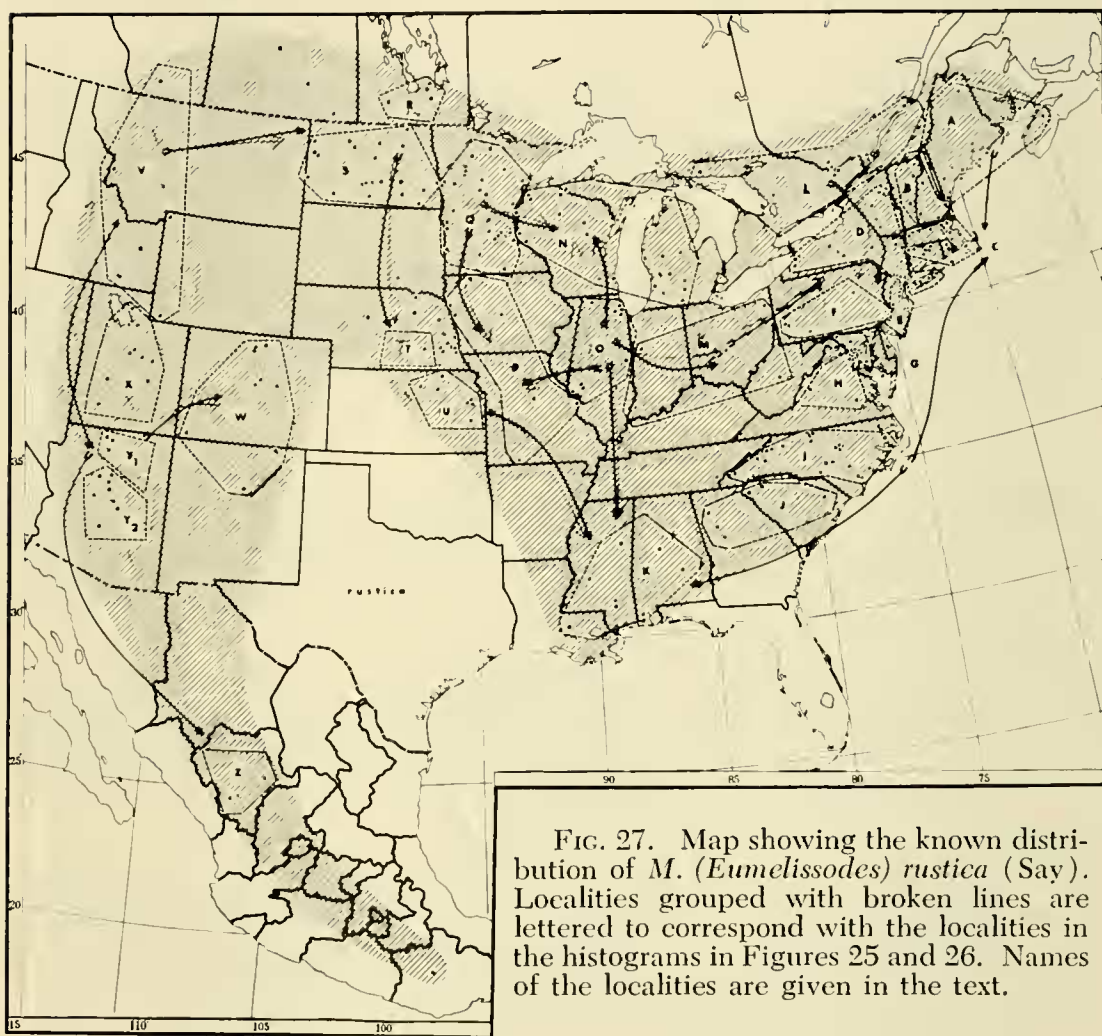


FIG. 27. Map showing the known distribution of *M. (Eumelissodes) rustica* (Say). Localities grouped with broken lines are lettered to correspond with the localities in the histograms in Figures 25 and 26. Names of the localities are given in the text.

Generally, the graphs show that the females are palest in the west and become progressively paler eastward. This is in accordance with the general rule of variation in the genus *Melissodes* (and related genera) previously proposed by LaBerge (1956, p. 917). However, the cline from west to east is not even, but various populations show deviations from the expected color pattern and several subclines occur in directions other than west-east. For instance, among the easternmost tier of populations the palest is from

North Carolina (I). Populations to the north of this region are progressively darker and the darkest are the southern New England populations (C). To the south of North Carolina the populations again become progressively darker and the darkest are the Alabama, Mississippi, Louisiana populations (K), although there are so few specimens from the latter areas that this conclusion is tentative.

Females from Illinois (O) are paler than those from areas to the north (N), the east (M), or the south (K). This is probably due to gene flow from western populations entering Illinois via the eastern extension of the prairies which reaches into that state. The palest of the prairie populations are in the northernmost part of the range and the populations in eastern Nebraska (T), eastern Kansas (U), and southeastward through Missouri become progressively darker. Specimens are lacking from the western parts of the great plains, except in the north (North Dakota, Manitoba, and Saskatchewan), and the species may well be absent from this area.

In the western parts of the species range, all females are quite pale in color. The palest population occurs in northern Arizona (Y1) and to the north and northeastward from this area the populations are slightly darker. Also, populations to the south (Central Arizona -Y2, Durango -Z) of this area are again somewhat darker in color.

This complicated system of minor clines within the major east-west cline is represented on the distribution map (Fig. 27) by a system of arrows. The palest populations are at or near the bases and the darker populations at or near the heads of the arrows. It should be emphasized that in several cases the lack of sufficiently large samples makes this description of the distribution of melanism quite tentative. In some cases females were grouped where they, perhaps, should not have been, simply because there were too few specimens from certain areas. For instance, specimens from Iowa were grouped with those from Missouri (P). Those from Iowa are very pale and intermediate between those from Nebraska and those in Illinois. The females from Missouri, on the other hand, are dark and are intermediate between the eastern Kansas females and the gulf coast populations. In all such cases, these facts were taken into account before drawing the arrows indicating subclines. In addition, specimens are almost wholly lacking from some areas of interest, such as Kentucky and Tennessee.

It should be evident from the facts of distribution presented here that each population is characterized by its own peculiar combination of characters (Fig. 25). Furthermore, the clines and subclines

do not exhibit any clear steps or breaks which one could logically use as limits for subspecies. A western and an eastern race might be recognized subspecifically, but this would result in a very large, rather indeterminate, intervening area in which the populations are intermediate in average melanism. In addition the populations in eastern Nebraska and eastern Kansas (and probably Iowa) would geographically fit into the eastern race or subspecies, but morphologically they are closer to the western race from which they are separated by a gap in the western parts of Nebraska and Kansas. Such a situation would not be taxonomically suitable and would make curating of specimens more difficult (because of the large number of intermediate specimens), rather than simplified.

In addition to color variation, the western populations average slightly larger than the eastern populations. But this character is not distributed in a generally east-west cline in the same fashion as is color. Time has not permitted the study of size variation in *M. rustica* at present.

*Bionomics.* This species is oligolectic on Compositae, as are most species of *Eumelissodes*. In the eastern parts of its range, it seems to prefer species of the genera *Solidago* and *Aster*. In the western parts of the range, it seems to prefer *Solidago*, *Aster*, *Grindelia* and *Aplopappus* in approximately that order. The flower data available from labels on specimens are summarized in Table XIV.

*Type Material.* Type specimens of *rustica* Say are destroyed. Lectotype, here designated, female of *simillima* Robertson collected by Charles Robertson at Carlinville, Illinois, September 15, 1889, on *Helenium autumnale* (Coll. No. 3259), and the lectoallotype male, here designated, of *simillima* Robertson collected by Charles Robertson at Carlinville on August 21, 1896, on *Helianthus divaricatus* (Coll. No. 18071) are in the collection of the Illinois Natural History Survey at Urbana. The holotype female of *ambigua* Smith from Mexico is in the British Museum (Natural History) in London (Type No. 17-B-837). The holotype female of *assimilis* Smith from Oaxaca, Mexico, in the British Museum (Natural History) (Type No. 17-B-862). The holotype female of *festinata* Provancher is in the Provancher collection in the Provincial Museum, Quebec, Canada. The lectotype female, here designated, of *asteris* Robertson, collected by Charles Robertson at Carlinville, Illinois, September 29, 1902, on *Aster ericoides villosus* is in the collection of the Illinois Natural History Survey at Urbana.



*Distribution.* *M. rustica* ranges from Nova Scotia in the northeast to Saskatchewan in the west and south to Georgia, Louisiana, New Mexico and Durango (Fig. 27). This species has been collected from May 31 to November 23, but chiefly during August and September. In addition to the type material, 904 females and 774 males

 TABLE XIV. Summary of Floral Records for *Melissodes rustica*.

Plant Data			Records of <i>M. rustica</i>			
FAMILY	Number of genera	Approximate number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae:						
<i>Solidago</i> spp.	1	8	58	73	57	130
<i>Aster</i> spp.	1	9	48	95	14	109
<i>Grindelia</i> spp.	1	1	26	25	26	51
<i>Aplopappus</i> spp.	1	1	6	26	2	28
<i>Helianthus</i> spp.	1	3	11	7	7	14
<i>Chrysopsis</i> spp.	1	1	3	13	1	14
Other genera	13	13	22	12	29	41
Brassicaceae	1	2	3	7	3	10
Labiatae	4	4	4	3	7	10
Leguminosae	1	2	3	2	3	5
Other families (3)	4	4	5	0	8	8
Totals	29	48	189	263	157	420

have been examined from the localities listed below. Localities reported in the literature are included in this list.

ALABAMA: Boothton; Kushla; Montgomery. ARIZONA: Flagstaff; Grand Canyon; Houserock Valley; Jacobs Lake (6 miles N.), Cocconino Co.; Oak Creek Canyon; Payson; Phoenix; Pine (2.9 miles N.); Prescott; Sedona; Williams. COLORADO: Bailey; Crossons; Elbert; Estes Park; Fort Collins; Glen Haven; Mesa Verde; Stonewall. CONNECTICUT: Colebrook; East Hartford; Manchester; Canaan; Rockville; Stafford; Storrs. DELAWARE: "Del." DISTRICT OF COLUM-

BIA: Anacostia, Carberry Meadow; Potomac Flats; Washington. GEORGIA: Atlanta; Cartersville; Griffin; Thomsons Mills. IDAHO: Idaho Falls; Roy. ILLINOIS: Berwin; Carlinville; Chicago; Elsau (Principia College); Fairmount; Macoupin Co.; Olive Branch; Palos Park; Rockford; Wilmette. INDIANA: Gibson Co.; Lafayette; Rush Branch. IOWA: Ames; Dickinson Co.; Onawa; Sioux City. KANSAS: Baldwin; Cloud Co.; Garnett; Lawrence; Lone Star Lake, Douglas Co.; Marysville; Riley Co. LOUISIANA: Addis. MAINE: Casco; Eliot; Indiantown Island; Leeds; Little Deer Island; Mt. Desert Island; Orono; Saco; Squirrel Island; Waldoboro; Washburn. MARYLAND: Beltsville; Bethesda; Cabin John; Chesapeake Beach; College Park; Glen Echo; Hancock; Mt. Airy; Plummerville; Yarrow. MASSACHUSETTS: Dedham; Duxbury; Forest Hills; Framingham; Hinsdale; Holden; Holliston; Middlesex Falls; Nantucket; Natick; Needham; North Attleboro; Reading Highlands; Wellesley; Woods Hole. MICHIGAN: Allegan Co.; Cheboygan (12 miles S. W.); Douglas Lake; Grand Rapids; Hillsdale Co.; Ingham Co.; Ionia Co.; Ironwood; Jackson Co.; Kalamazoo Co.; Keweenaw Co.; Mecosta Co.; Midland Co.; Muskegon Co.; Oceana Co. MINNESOTA: Barrett; Beltrami Co.; Bengal; Bigstone Co.; Carver Co. (Zumbro Heights); Cass Co.; Clay Co.; Cokato; Detroit Lakes; Duluth; Fort Snelling; Hastings; Hayward; Hendricks; Hennepin Co.; Itasca State Park; Koochiching Co.; Lake Itasca; Lake Lena; Lake Vadnais; Ramsey Co.; Minnetonka Lake; Moorhead; Ortonville; Pelican Lake; Pine Co.; Pine River; Ramsey Co.; Savannanoa; Shevlin; Sleepy Eye; St. Anthony Park; St. Cloud; St. Paul. MISSISSIPPI: Camp Shelby; Hattiesburg; Jackson; State College. MISSOURI: Branson; Columbia; St. Louis. MONTANA: Hamilton; Three Forks. NEBRASKA: Ashland; Cedar Bluffs; Halsey; Lincoln; Malcolm; Nebraska City; Neligh; Niobrara; Omaha; Wabash; Weeping Water; West Point, York Co. NEW HAMPSHIRE: Alstead; Durham; Franconia; Lancaster; Pelham. NEW JERSEY: Englewood; Fort Lee; Gloucester; Lakewood; Montclair; Newark; New Brunswick; Palisades Park; Plainfield; Pt. Pleasant; Ramsey; South Orange; Trenton; Westville. NEW MEXICO: Chicoric Canyon (near Raton); Rowe. NEW YORK: Brooklyn; Cold Spring Harbor; Copake Falls; Covert; Seneca Co.; East Aurora; Geneva; Gloversville; Gowanda; Hague; Hamburg; Ithaca; Keene Valley, Essex Co.; Lake Placid; Long Island (sea cliffs); Long Lake (7 miles S.); Moshulu; New Baltimore; New Rochelle; New York City; Nyack; Oneonta; Pine Island; Poughkeepsie; Quogue; Southampton; Speculator; Staten Island; Tappan;

Tuxedo Park. NORTH CAROLINA: Black Mountains (valley of); Bryson City; Busick; Burgaw; Church Island; Crabtree Creek St. Park; Davidsons River; Doughton Point; Grandfather Mt.; Holly Shelter; Lakeview; Linville; McCullers; Marion; Mayodan; Rockingham Co.; Moyoc; New River; Raleigh; Reidsville; Richmond Co.; Sampson Co.; Spout Springs; Wake Co.; Washington Co.; Wilkesboro. NORTH DAKOTA: Beach; Bismarck; Cannon Ball; Carpio; Devils Lake; Edgeley; Enderlin; Fargo; Jamestown; McKenzie; Mandan; Martin; Minot; Mott; Nicholson; Rawson; Rugby; Schafer; Steele; Wales; Williston. OHIO: Columbus; Trumbull Co. PENNSYLVANIA: Bloomsburg; Braddock; Central City, Darby; Delaware Co.; Glenside; Lawndale; Philadelphia; Pittsburgh; Wilawana. RHODE ISLAND: Block Island; Providence. SOUTH CAROLINA: Clemson College; Florence; Greenville. SOUTH DAKOTA: Platt. TENNESSEE: Monroe Co. UTAH: Alta (2 miles W.); Carbon Co.; Clear Creek Canyon; Cove Fort; Emery Co.; Lakepoint; Mt. Nebo; Ogden; Parowan; Pine Valley Mts.; Thistle Canyon. VERMONT: Lyndon; Woodstock. VIRGINIA: Alexandria; Barcroft; Falls Church; Fort Humphreys; Glencarlyn; Goshen; Kearney; Long Bridge (S. end of); Loudoun; Newington; Richmond; Rosemont; Tangier Island. WEST VIRGINIA: Millville; Southburg. WISCONSIN: Farmington; Hudson; Iron Co.; Langlade Co.; Maiden Rock; Milwaukee; Morris; Price Co.; Randall; St. Croix Dam, Douglas Co.; Wascott. WYOMING: Uinta Co.; Yellowstone National Park. *Canada*. ALBERTA: Lethbridge. MANITOBA: Aweme; Balmoral; Teulon; Treesbank; Winnipeg. NEW BRUNSWICK: Nerepia, St. John. NOVA SCOTIA: Kings Co. ONTARIO: Carp (5 miles W.); Muskoka; Ottawa; Spencesville; Sudbury; Toronto. QUEBEC: Aylmer (Queen's Park); Cap Rouge; Hemmingford; Hull; Kazabazua; Montreal. SASKATCHEWAN: Earl Grey; Estevan; Saskatoon. *México*. DURANGO: Coyotes El Salto (6 miles N. E.); Otinapa; Palo Colorados. OAXACA: Oaxaca.

*Flower Records.* *Abutilon theophrasti*, *Amphiachyris dracunculoides*, *Aplopappus* sp., *A. gracilis*, *Asclepias* sp., *Aster* sp., *A. anomalus*, *A. commutatus*, *A. crenulis*, *A. dumosus*, *A. ericoides*, *A. e. villosus*, *A. exiguus*, *A. grandiflorus*, *A. laevis*, *A. lateriflorus*, *A. multiflorus*, *A. novaeangliae*, *A. paniculatus*, *A. praeatus*, *A. sagittifolius*, *A. salicifolius*, *A. turbinellus*, *Baccharis* sp., *Bidens aristosa*, *B. laevis*, *B. asteroides*, *Centaurea juncea*, *Chrysopsis* sp., *C. mariana*, *Cirsium arvense*, *C. lanceolatum*, *Cleome lutea*, *C. serrulata*, *Coreopsis tripteris*, *Cosmos* sp., *Epilobium* sp., *E. perfoliatum*, *Gail-*



*lardia* sp., *Grindelia* sp., *G. squarrosa*, *Helenium* sp., *H. autumnale*, *H. tenuifolium*, *Helianthus* sp., *H. atrorubens*, *H. divaricatus*, *H. grosse-serratus*, *H. maximillianus*, *H. petiolaris*, *H. radula*, *H. tuberosus*, *Heliopsis helianthoides*, *Hieracium scabrum*, *Lycopus americanus*, *Marrubium vulgare*, *Melilotus alba*, *M. officinalis*, *Mentha* sp., *Physostegia parviflora*, *Polymenantha* sp., *Ratibida columnaris*, *R. pinnata*, *Rudbeckia laciniata*, *R. subtomentosa*, *R. triloba*, *Silphium perfoliatum*, *Solidago* sp., *S. altissima*, *S. canadensis*, *S. graminifolia*, *S. juncea*, *S. nemoralis*, *S. rigida*, *S. rugosa*, *S. serotina*, *Spiraea alba*, *Verbena* sp., *V. hastata*, *V. stricta*, *Verbesina virginica*, *Vernonia fasciculata*, *V. glauca*.

*Melissodes (Eumelissodes) grindeliae* Cockerell

*Melissodes grindeliae* Cockerell, 1898, Bull. Sci. Labs. Denison Univ., vol. 11, pp. 66, 67; 1899, Bull. Univ. New Mexico, vol. 1, pp. 66, 67; 1899, Canadian Ent., vol. 31, p. 256; 1901, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 130; 1901, Ent. News, vol. 12, p. 40; 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 12, p. 450; 1905, Bull. S. California Acad. Sci., vol. 4, p. 103; 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 77, 88, 92; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309; Viereck, 1906, Trans. Amer. Ent. Soc., vol. 32, p. 238; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 237; Cockerell, 1907, Univ. Colorado Studies, vol. 4, p. 255; Tucker, 1909, Trans. Kansas Acad. Sci., vol. 22, p. 281; Cockerell, 1910, Ann. Mag. Nat. Hist., ser. 8, vol. 5, p. 257; 1919, Jour. New York Ent. Soc., vol. 27, p. 300; 1930, Amer. Mus. Nov. No. 397, p. 1; Brimley, 1938, Insects of North Carolina, p. 462.

This species is related to *M. rustica* and *M. pallidisignata*, but can be distinguished from these species by the longer first flagellar segments of the male, the broader pale pubescent bands of the terga, and the sparser and finer punctation of the terga of both sexes as described below. In addition, the female differs from those of *rustica* and *pallidisignata* by the generally ochraceous scopal hairs, ochraceous to yellow pale pubescent tergal bands (especially on terga 3 and 4), and the presence of fine, suberect hairs in the apical areas of terga 2 and 3.

*Female.* Measurements and ratios: N, 20; length, 10-13 mm.; width, 3.0-4.5 mm.; wing length,  $M = 3.82 \pm 0.178$  mm.; hooks in hamulus,  $M = 12.70 \pm 0.193$ ; flagellar segment 1/segment 2,  $M = 1.98 \pm 0.027$ .

Structure and color: Integument black except as follows: apical half of mandible and distitarsi rufescent; flagellar segments 3-10 slightly rufescent beneath, especially last 3 or 4 segments; eyes blue to grayish green; wing membranes slightly infumate, veins brown to black; tegulae piceous; tibial spurs white to slightly rufescent; metasomal tergum 1 with extremely narrow apical margin hyaline.

Structure and punctation as in *pallidisignata* except as follows:

clypeal punctures large, shallow, round, separated mostly by half a puncture width except medially where longitudinal median carina usually present at least in apical half; galeae above shiny, unshagreened except at extreme tips; maxillary palpal segments in ratio of about 4.0:2.5:2.5:1.0, first and last segments often shorter. Mesoscutum with anterior third punctures deep, separated by one-third to one puncture width (but mostly by less than one), posteromedian area punctures separated mostly by two to four puncture widths; surface often slightly dulled by extremely fine, reticular shagreening; mesepisternal punctures distinct, separated by half a puncture width or less, surface shiny, unshagreened or slightly so. Tergum 1 with basal three-fifths with punctures small, shallow, separated by two to three puncture widths (medial half), apical area impunctate, surface dulled by fine, dense, reticulotranverse shagreening, apical and basal areas not strongly contrasting in shagreening; tergum 2 with basal area punctures minute, distinct, separated by two to three puncture widths, interband zone punctures of similar size or smaller, extremely sparse and often absent medially, apical area impunctate, surface of basal area shiny to slightly dulled, of interband and apical area dulled by shagreening as in tergum 1; terga 3 and 4 similar to 2 but basal punctures more abundant and apical areas smaller or absent; terga 2 and 3 without conspicuously larger punctures at bases of bristlelike hairs.

Hair: Head white to pale ochraceous with abundant dark brown on vertex; thorax laterally white to pale ochraceous, occasionally mesepisterna brown on ventral, anterior and lower lateral surfaces, dorsally scutellum dark brown except pale fringe and mesoscutum with posteromedian dark patch extending forwards usually beyond a transverse line at anterior margins of tegulae, pale hairs of mesoscutum pale ochraceous to yellowish, but not rufescent. Tergum 1 with basal area ochraceous to yellowish; tergum 2 with basal area white to pale ochraceous, interband zone dark brown, distal band pale ochraceous to slightly yellow, basal and distal pale bands connected at extreme sides by pale pubescence, distal band not usually interrupted medially, but narrowed and often reaching apex at extreme sides, apical area with abundant, suberect, ochraceous to brown, relatively simple, long hairs (unless worn); tergum 3 similar except basal tomentum dark brown, distal band broader, reaching apex of tergum in about lateral thirds, often slightly yellowish, tergum 4 with apical pale band usually yellowish to almost orange, of equal width across tergum, never interrupted;

terga 5 and 6 with small tufts of pale hairs laterally; sterna dark brown, usually pale laterally. Legs white to ochraceous except as follows: anterior tarsi, middle and hind distitarsi, inner surfaces middle and hind basitarsi, and pygidial plates reddish brown to dark brown.

*Male.* Measurements and ratios: N, 20; length, 9-12 mm.; width, 2.5-4.0 mm.; wing length,  $M = 3.56 \pm 0.166$  mm.; hooks in hamulus,  $M = 12.05 \pm 0.235$ ; flagellar segment 2/segment 1,  $M = 3.22 \pm 0.062$ .

Structure and color: Integument black except as follows: clypeus yellow except rufescent to piceous apical margin; apical half of mandible and distitarsi rufescent; eyes green to yellow-brown; wing membranes colorless to slightly infumate, veins reddish brown to dark brown; tegulae piceous; tibial spurs yellow to rufescent; apical areas of terga hyaline, colorless to yellow; labrum and mandibles without yellow spots.

Structure as in *pallidisignata* except as follows: first flagellar segment minimum length about one-third maximum length of second segment, penultimate segment three times as long as broad or shorter, flagellum just reaching pterostigma in repose or shorter; maxillary palpal segments in ratio of about 3.0:2.0:2.2:1.0, last segment often shorter, second segment often slightly longer. Sculpturing as in female except as follows: mesoscutal posteromedian impunctate area often smaller or with sparse punctures; tergum 1 with basal four-fifths to five-sixths punctate, punctures slightly larger, separated by one to three puncture widths; tergum 2 with basal area punctures separated by one to three puncture widths; terga 2-4 with interband zone punctures slightly coarser and slightly more abundant; sterna usually with surface somewhat dulled by reticular shagreening. Terminalia as in *rustica*.

Hair: Head and thorax with pale hairs white to yellow, brighter on dorsum of thorax, vertex often dark brown, scutellum and mesoscutum usually with abundant dark brown, most often lacking on mesoscutum, tegulae usually with at least a few brown hairs. Tergum 1 ochraceous; tergum 2 as in female but interband zone hairs erect and partly pale, apical area hairs suberect, longer and often brown; terga 3 and 4 similar to 2 but interband zone erect hairs partly to wholly brown, distal pale pubescent bands reaching apex of tergum at least in lateral thirds, on tergum 4 often across entire tergum; tergum 5 similar to 4 but apical area obliterated; terga 6 and 7 yellow apically, brown basally; sterna yellow to brown



TABLE XV. Summary of Floral Records for *Melissodes grindeliae*.

Plant Data			Records of <i>M. grindeliae</i>			
FAMILY	Number of genera	Approximate number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae:						
<i>Ratibida</i> spp.	1	2	5	54	8	62
<i>Chrysopsis</i> sp.	1	1	2	76	10	86
<i>Rudbeckia</i> sp.	1	1	1	19	0	19
<i>Haplopappus</i> sp.	1	1	1	10	0	10
<i>Grindelia</i> sp.	1	1	4	7	0	7
Others	7	7	10	8	42	50
Leguminosae	3	5	7	2	8	10
Other families	5	5	6	5	22	27
Totals	20	23	36	181	90	271

medially. Legs pale ochraceous to yellow except golden yellow to orange on inner surfaces of tarsi.

*Bionomics.* *M. grindeliae* is an oligolege of composites, but it is not restricted to the genus *Grindelia* for pollen, as its name implies. In fact, *Grindelia* seems to play a relatively small role in the flower preferences of this bee. Table XV summarizes the floral data available from labels on specimens examined by the author. It can be seen that several genera of composites other than *Grindelia* are as important, if not more so, than the latter as pollen sources for this bee.

*Type Material.* Cockerell (1898) apparently did not select a holotype from among the specimens from which he described this species. I have seen three specimens which are undoubtedly a part of the original type series, although none of them are marked as types. Of these I hereby select as the lectotype of *grindeliae* a female bearing the following collection data: Ckll. 3943; Sta. Fe; July; on *Lepachys*. This specimen bears a label in Cockerell's hand identifying the bee as *Melissodes grindeliae*. This specimen is in

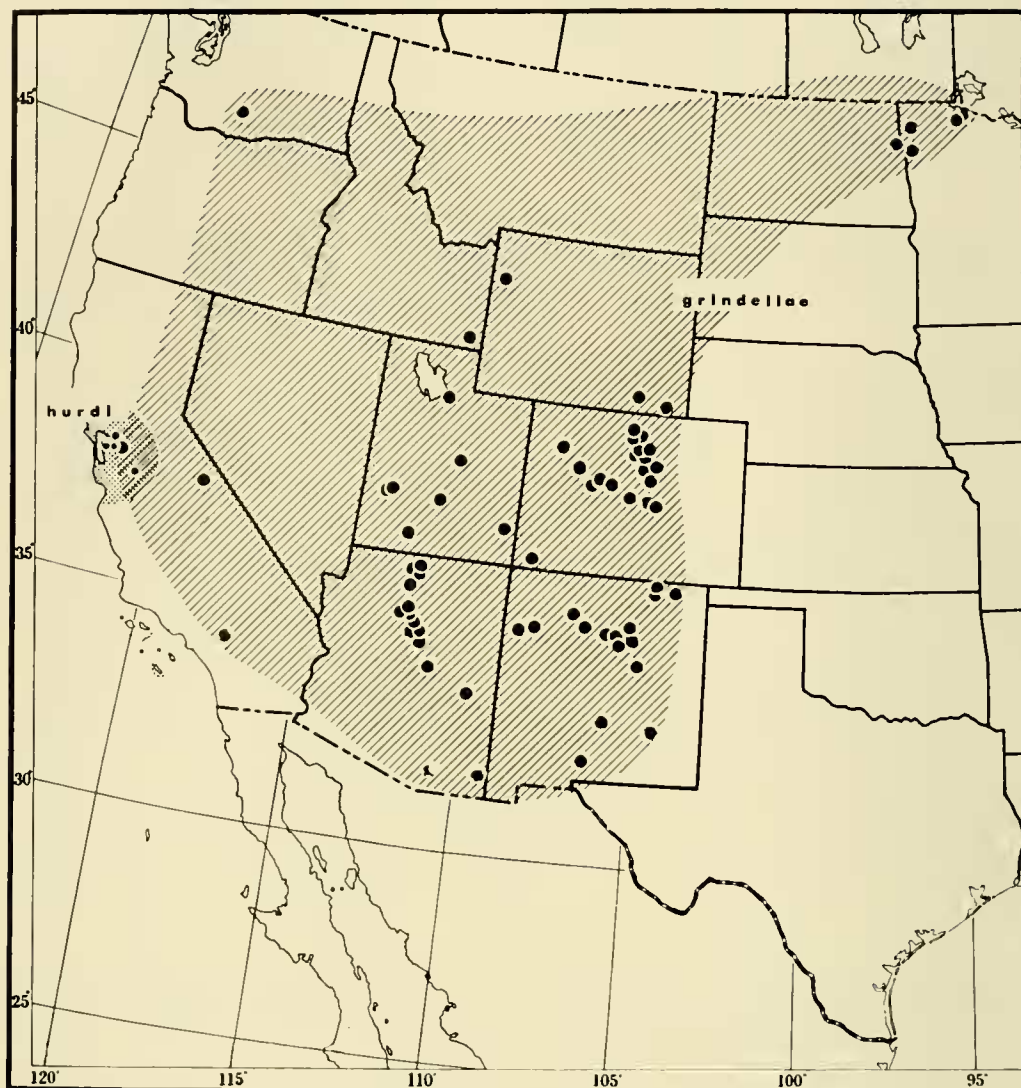


FIG. 28. Map showing the known distributions of *M. (Eumelissodes) grindelliae* Cockerell and *M. (E.) hurdi* LaBerge.

the collection of P. H. Timberlake at the Citrus Experiment Station, Riverside, California.

*Distribution.* This species is distributed from Washington and Idaho to Arizona and New Mexico and from California to Minnesota and Colorado (Fig. 28). It has been collected from June 26 to September 27, but mainly during July. Including the type material, 367 females and 188 males have been examined from the localities listed below (the list includes records from the literature).

ARIZONA: Chiricahua Mts. (Rustlers Camp), Cochise Co.; Coconino Co.; Flagstaff; Grand Canyon; Houserock Valley; Humphreys Peak (at base); Jacob Lake (11 miles N. W.); Kaibab Forest; McNary Junction (6 miles S.), Apache Co.; Maine, Coconino Co.; Mogollon Rim; Mormon Lake; Oak Creek Canyon; San Francisco

Mts.; Santa Rita Mts.; Todd's Lodge, Oak Creek Canyon; Walnut Canyon (near Flagstaff). CALIFORNIA: Antioch; Mammoth; Upper Santa Ana River, San Bernardino Co. COLORADO: Aspen; Aurora (Bear Creek); Big Thompson Canyon; Boulder; Colorado Springs (Palmer Park); Eleven-mile Canyon, Park Co.; Estes Park; Glen Haven; Glenwood Springs; Golden (Lookout Mt.); Jim Creek (near Boulder); La Poudre River (Indian Meadows); Leadville; Meeker; Mesa Verde; Mt. Alto; Overland Lake, Boulder Co.; Peaceful Valley; Platte Canyon; Rock Creek Canyon (near Colorado Springs); Sedalia. IDAHO: Cub River Canyon. MINNESOTA: Baudette; Lake of the Woods Co.; Marshall Co.; Polk Co. NEW MEXICO: Capulin; Colfax Co.; Dripping Spring (Organ Mts.); Jemez Springs; La Jara (5 miles E.), Sandoval Co.; La Tenaja; Las Vegas; Nogal; Pecos; Raton Pass; Roswell (5 miles S.); Rowe; Sandia Mts.; San Ignacio; Santa Fe; Sapello; Thoreau (8 miles N.), McKinley Co.; Tuerto Mts. NORTH DAKOTA: Grand Forks; Hardeys Peak. UTAH: Alton; Beaver Mts.; Beaver Valley; Bicknell (17 miles S.); Cedar Point; Clear Creek Canyon; Lake Canyon; Monticello; Salt Lake. WASHINGTON: White Swan (8 miles S.W.), Yakima Co. WYOMING: Cheyenne; Grand Teton National Park; Laramie.

*Flower Records:* *Aster commutatus*, *Chrysopsis hispida*, *Chrysanthamnus nauseosus*, *Cleome* sp., *C. serrulata*, *Croton* sp., *Grindelia* sp., *G. squarrosa*, *Haplopappus* sp., *Helianthus* sp., *Hymenoxys floribunda*, *H. richardsonii*, *Liatris punctata*, *Lupinus* sp., *Melilotus* sp., *M. alba*, *M. officinalis*, *Petalostemum* sp., *P. occidentale*, *Phacelia glandulosa*, *Polymenantha* sp., *Psilostrophe gnaphaloides*, *Ratibida* sp., *R. columnaris*, *R. tagetes*, *Rudbeckia laciniata*, *Verbena stricta*.

*Melissodes (Eumelissodes) hymenoxidis* Cockerell

*Melissodes hymenoxidis* Cockerell, 1906, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 443; 1910, Psyche, vol. 17, p. 246; 1915, Ann. Mag. Nat. Hist., ser. 8, vol. 15, p. 269; 1918, Ann. Mag. Nat. Hist., ser. 9, vol. 1, p. 160; 1928, Univ. Colorado Studies, vol. 16, p. 114; 1933, Trans. Ent. Soc. Amer., vol. 26, p. 44; 1936, Amer. Mus. Nov. No. 831, p. 5; Bohart, Knowlton and Bailey, 1950, Utah St. Agric. Col., Mimeo. Ser. 371, p. 5.

*Melissodes fremontii* Cockerell, 1907, Entomologist, vol. 40, p. 268 (new synonymy); Clements and Long, 1923, Expt. Pollination, Carnegie Inst. of Washington, Publ. No. 336, p. 249.

*Melissodes kelloggi* Cockerell, 1919, Ent. News, vol. 30, p. 293 (new synonymy); 1928, Univ. Colorado Studies, vol. 16, p. 114; Bohart, Knowlton and Bailey, 1950, Utah St. Agric. Col., Mimeo. Ser. 371, p. 5.

*Melissodes hymenoxidis* is a small dark bee related to *M. rustica* and *M. grindeliae*. Both sexes are distinctive in the extremely shiny surfaces of the body, especially of the terga. The second tergum has the interband zone completely without shagreening in the lat-



eral raised areas (shagreening is not visible here even at magnifications of 100 times with a dissecting scope). The female has abundant dark hair on the head, lateral surfaces of the thorax and abdomen, much as in the darker specimens of *rustica*, but the pale hairs of the head and thorax are white or cinereous rather than ochraceous to rufescent. The males have the long second flagellar segments of this group of species and hyaline tergal apices.

*Female.* Measurements and ratios: N, 20; length, 10-12 mm.; width, 3-4 mm.; wing length,  $M = 3.45 \pm 0.128$  mm.; hooks in hamulus,  $M = 11.90 \pm 0.261$ ; flagellar segment 1/segment 2,  $M = 2.07 \pm 0.035$ .

Structure and color: Integument black except as follows: apical half of mandibles and distitarsi rufescent; eyes green; flagellar segments 3-10 dark reddish brown below; tibial spurs yellow; wing membranes hyaline, veins dark brown; tegulae piceous; apical margin of tergum 1 narrowly hyaline or lighter brown.

Structure and sculpture as in *pallidisignata* except as follows: clypeus usually with well-marked median longitudinal carina; clypeus and supraclypeal area with surface unshagreened, shiny; galeae unshagreened above, or slightly so in apical half or less; vertex with flattened lateral areas with small punctures, surface unshagreened; mesoscutal punctures small and crowded anteriorly (here smaller than mesepisternal punctures), posteromedially sparse or absent, surface unshagreened; mesepisternal punctures size of posteromedian mesoscutal punctures, separated mostly by half a puncture width or less, surface unshagreened; tergum 1 with basal three-fifths punctate, punctures shallow, large, separated mostly by half to one puncture width (medially), or slightly more, surface somewhat dulled by fine reticular shagreening, apical impunctate area with extremely fine reticulotransverse shagreening scarcely dulling surface; tergum 2 with basal area punctures separated mostly by half a puncture width, surface unshagreened, interband zone punctures large, deep, separated by one to three puncture widths, surface shiny, extremely finely shagreened medially and completely unshagreened in lateral raised areas, apical area as in tergum 1; tergum 3 similar to 2 but interband zone punctures slightly more crowded and apical area smaller and with minute round punctures near distal pubescent band; tergum 4 with apical area lacking.

Hair: Pubescence and hair long, slender, shiny and silky (especially on abdomen). Head black except a few cinereous hairs on face below vertex. Thorax with sides black to dark brown; above

white to cinereous except medial scutellar hairs and small postero-median mesoscutal patch of brown; tegulae usually with some brown; dorsal and posterior surfaces of propodeum white to cinereous. Tergum 1 dark brown on anterior and lateral surfaces, dorsally white to cinereous except brown posterolaterally; tergum 2 with basal tomentum white, interband zone with erect to suberect, dark brown hairs and many strong and bristlelike, distal pubescent band dark brown or pale in lateral fourth of tergal width, distal band when pale not connected with pale basal tomentum nor reaching apex of tergum laterally; tergum 3 similar to 2 but basal tomentum dark brown, distal pubescent band white, although usually interrupted medially and often by as much as one-third tergal width, apical area with abundant subappressed, relatively simple, long, dark brown hairs; tergum 4 with apical pale band narrower than basal dark area and usually interrupted medially by brown but not so much as in tergum 3; tergum 5 and 6 and sterna dark brown to black. Legs brown to dark brown except as follows: scopal hairs pale ochraceous to yellow except apically on basitarsus and on basitibial plates, hind tibiae on inner surfaces yellow.

*Male.* Measurements and ratios: N, 14; length, 9-11 mm.; width, 2.5-3.0 mm.; wing length,  $M = 3.09 \pm 0.095$  mm.; hooks in hamulus,  $M = 10.93 \pm 0.287$ ; flagellar segment 2/segment 1,  $M = 3.48 \pm 0.376$ .

Structure and color: Integument black except as follows: apical half of mandibles, distitarsi and often basitarsi and tibiae rufescent; clypeus yellow except reddish brown apical margin; labrum and mandibles without pale maculae; flagellum yellow beneath, dark reddish brown to black above (segment 2 often entirely brown); eyes bluish green to green; wing membranes colorless, veins reddish brown to black; tegulae piceous; tibial spurs yellow; tergal apical areas hyaline, colorless.

Structure as in *pallidisignata* except as follows: flagellum reaching prestigma and rarely pterostigma in repose; maxillary palpal segments in ratio of about 7:7:4:1, second segment often slightly less and last segment as much as twice as long. Sculpturing as in female except as follows: tergum 1 with basal five-sixths or more punctate; tergum 2 with basal zone punctures separated by about half a puncture width at extreme base to two or three puncture widths near interband zone, interband zone with surface extremely shiny and unshagreened even medially; terga 3-5 similar to tergum

2 but punctures more abundant in interband zones. Terminalia as in *rustica*.

Hair: Vestiture silky as in female; white to cinereous except as follows: vertex occasionally with sparse brown hairs; scutellum occasionally and mesoscutum rarely with brown medially; terga 2-5 with interband zones partly or wholly brown, bristlelike hairs abundant, strong, often dark, erect; terga 2-6 with complete white distal pubescent bands and terga 3-4 with a few subappressed, white relatively simple, apical hairs; terga 3-5 with basal tomentum brown; terga 6 and 7 pale; sterna pale or slightly yellowed medially; legs white except inner surfaces of tarsi yellow.

*Bionomics.* Little can be said about the flower preferences of *hymenoxidis*, since the floral records are too sparse. It has been collected on a mint (one female), on *Grindelia* (one female), and (type series) two females were seen to visit successively *Hymenoxys ligulaeflora* and *Chrysopsis* sp.

*Type Material.* Cockerell described *M. hymenoxidis* from a series of three females. Of these, two have been located and both bear the label "cotype." The third specimen, which was presumably the holotype, has been lost or destroyed. As Cockerell did not refer to any single specimen in his original description as the holotype, the lost specimen cannot be certainly identified as such. Therefore, the female specimen in the collection of the American Museum of Natural History, New York City, is hereby designated as the lectotype of *M. hymenoxidis* Cockerell (AMNH Type No. 21149). This female was taken by T. D. A. Cockerell at Florissant, Colorado on July 17. The holotype male of *kelloggi*, collected by T. D. A. Cockerell at Longs Peak Inn, Colorado on July 19, is in the collection of the U. S. National Museum (Type No. 22591). The holotype male of *fremontii*, collected by S. A. Rohwer at Florissant, Colorado on July 23, 1907, is in the collection of the Museum of Natural History at the University of Colorado, Boulder.

*Distribution.* *M. hymenoxidis* ranges from eastern California to Colorado and north to Montana (Fig. 15). It has been collected from June 25 to August 29, but mainly in July. In addition to the type material, 47 females and 15 males have been examined from the localities listed below (this list includes records reported in the literature).

CALIFORNIA: Convict Lake, Mono Co.; Duck Lake, Mono Co.; Walker River (Leavitt Meadow), Mono Co. COLORADO: Boulder Co. (Science Lodge); Creede; Eldora; Florissant; Leadville; Longs



Peak Inn; Medicine Bow Mts.; Meeker; Ouray (Summit Road); Pingree Park, Larimer Co.; Tennessee Pass; Tolland; Ward. MONTANA: Missoula. UTAH: Randolph; Strawberry Reservoir. WYOMING: Bondurant; Grand Teton National Park; Owl Creek Mts.; Larimer (S. E.).

*Flower Records.* *Chrysopsis* sp., *Grindelia* sp., *Hymenoxys lingulaeflora*, a mint.

*Melissodes (Eumelissodes) illata* Lovell and Cockerell

*Melissodes illata* Lovell and Cockerell, 1906, *Psyche*, vol. 13, p. 110; Criddle, Curran, Viereck, and Buckell, 1924, *Rept. Ent. Soc. Ontario*, vol. 33, p. 99; Proctor, 1938, *Biol. Surv. Mt. Desert Region*, vol. 6, p. 444.

*Melissodes illata* is a small, dark, northern species from eastern North America. It is distinctive in the almost complete lack of punctuation in the interband and apical areas of the terga of both sexes and differs in this way from members of the *coreopsis* group to which it appears to be allied. It is closely related to the species immediately following and the differences are given in the diagnosis of the latter.

*Female.* Measurements and ratios: N, 20; length, 8-11 mm.; width, 3-4 mm.; wing length,  $M = 3.08 \pm 0.113$  mm.; hooks in hamulus,  $M = 11.35 \pm 0.196$ ; flagellar segment 1/segment 2,  $M = 1.88 \pm 0.033$ .

Structure and color: Integument black except as follows: apical half of mandible and distitarsi rufescent; flagellar segments 3-10 paler beneath but rarely red, usually dark brown, often mostly black; eyes dark gray to green; wing membranes clear, slightly infumate, veins black; tegulae piceous; tibial spurs yellow; tergum 1 with apex extremely narrowly or not at all hyaline.

Clypeus flat as in *coreopsis*, with crowded punctures separated mostly by half a puncture width or slightly more, dulled by coarse reticular shagreening; supraclypeal area with sparse punctures, almost always opaque, dulled by coarse tessellation; galeae above shiny, usually unshagreened or with shagreening in less than apical half, rarely more; lateral areas of vertex with small punctures separated mostly by two to four puncture widths, surface shiny; maxillary palpal ratio about 2.8:2.4:2.0:1.0, occasionally with minute fifth segment present. Mesoscutum with deep round punctures anteriorly and peripherally separated by half to one and posteromedially by one to three puncture widths, surface often with fine tessellation especially posteromedially; scutellum similar to mesoscutum; mesepisternum with punctures larger and shallower than

mesoscutal, surface dulled by irregularly reticulate shagreening or fine tessellation at least in upper third. Metasomal tergum 1 with shallow punctures in basal three-fifths separated mostly by one puncture width, apical area impunctate, anterolateral lobes of apical area impunctate or punctures sparse, surface dulled by dense reticulotransverse shagreening especially basally; tergum 2 with basal area punctures minute, separated mostly by two puncture widths or more, surface shiny or dulled by reticular shagreening, with interband zone impunctate or with sparse, irregular punctures peripherally, surface as basal area of tergum 1, with apical area impunctate, surface dulled as in tergum 1; tergum 3 similar to 2; tergum 4 similar but beneath apical pubescence medially with minute punctures usually less than twice diameter of hairs arising from them; pygidial plate V-shaped, basal width subequal or slightly more than median length, apex rounded.

Hair: Pale hairs and pubescence white except extremely pale ochraceous on mesoscutum and pronotum; vestiture in general as in darker specimens of *coreopsis*. Head with abundant dark brown on vertex and often brown on labrum and apex of clypeus. Mesoscutum with posteromedial dark patch more than twice size of scutellar dark area, often mesoscutal hairs almost all black; posterior pronotal lobes usually with at least a few dark hairs and often most pronotal hairs dark; ventral mesepisternal hairs occasionally dark brown. Tergum 1 pale basally, apically usually glabrous or with short, simple, appressed, dark brown hairs basally and in anterolateral lobes; tergum 2 with basal area white, distal pale band white, narrowly to broadly interrupted medially, interband zone with short, suberect, dark brown hairs, apical area with scattered, short, appressed, brown hairs near white pubescence and glabrous apically; tergum 3 similar to 2 but basal tomentum brown, distal white band usually narrowly interrupted and occasionally not at all, and apical area hairs more abundant; tergum 4 as in 3 but distal white band apical and interrupted medially by triangular area of suberect brown pubescence; tergum 5 usually with small lateral pale tufts; tergum 6 without lateral pale tufts; sterna dark brown, usually pale laterally. Legs as in *coreopsis* but scopal hairs often yellow.

*Male.* Measurements and ratios: N, 20; length, 8-10 mm.; width, 2.5-3.5 mm.; wing length,  $M = 2.97 \pm 0.190$  mm.; hooks in hamulus,  $M = 10.40 \pm 0.134$ ; flagellar segment 2/segment 1,  $M = 7.38 \pm 0.102$ .

Structure and color: Integument black except as follows: clypeus yellow except testaceous apical margin and dark tentorial pits; labrum with cream-colored mediobasal macula; mandibles rarely with minute basal yellow maculae; flagellar segments 2-11 usually red beneath, often somewhat infuscated towards base and tip; eyes gray-brown to green; wing membranes clear, veins dark brown; tibial spurs yellow; tegulae piceous; metasomal terga with apical areas piceous.

Structure and color: Structure as in *coreopsis* with the following exceptions and additions: minimum length first flagellar segment usually equals one-eighth to one-ninth maximum length second segment and always less than one-seventh second; maxillary palpal ratio about 4.0:3.3:3.3:1.0, rarely with minute fifth segment. Sculpturing as in female except as follows: tergum 1 with minute sparse punctures to within one-sixth of apical margin; terga 4 and 5 like tergum 3. Terminalia as in *agilis* but sternum 8 with ventral tubercle lamelliform with rounded apex; sternum 7 with median plate with ventral hairs sparse.

Hair: As in *coreopsis* except as follows: head with abundant brown on vertex; mesoscutum often mostly dark brown, always with at least a few brown hairs posteromedially; tergum 1 white basally, with short, brown, suberect to erect hairs apically; tergum 2 with distal white band narrow, occasionally uninterrupted, interband zone hairs longer, suberect to erect, apical area hairs sparse, long, subappressed to suberect; terga 3-5 usually with completely distal white bands, that on 5 often interrupted medially; terga 6 and 7 and sterna dark brown. Legs white except inner surfaces tarsi yellow.

*Bionomics.* This species is an oligolege of composites and seems to prefer the genera *Solidago* and *Aster* in that order. The floral data are too sparse, however, to give a clear indication of preferences.

*Type Material.* Lectotype male, here designated, of *illata* from Waldoboro, Maine, collected by J. H. Lovell, August 13, 1905, on *Solidago* sp., is in the collection of T. B. Mitchell, North Carolina State College, Raleigh. The lectoallotype female, here designated, from Waldoboro, Maine, collected by J. H. Lovell, August 26, on *Solidago* sp., is deposited with the holotype, but belongs to the next species described. Two paratypes (male and female) from Waldoboro collected by J. H. Lovell as follows: male, July 23, on *Epilobium angustifolium* and female, August 3, 1905, on *Solidago* sp.,



are in the collection of the Natural History Museum of the University of Colorado at Boulder. These last two also seem to belong to the next described species, rather than to *M. illata*.

*Distribution.* In Canada from Prince Edward Island west to Alberta and in the United States south to North Carolina and Illinois (Fig. 29). This species has been collected from July 7 to September 19, chiefly in August. In addition to the type material, 146 females and 60 males have been examined from the localities listed below (one female and two males from Colton, California, Pilate collector, are considered to be mislabeled).

CONNECTICUT: Colebrook; Stafford. ILLINOIS: Sheridan. MAINE: Little Deer Island; Mt. Desert; Perry; Saco; Waldoboro; Winthrop. MASSACHUSETTS: Needham. MICHIGAN: Alger Co.; Baraga Co.; Bay City; Bay Co.; Cheboygan; Cheboygan Co.; Delta Co.; Dickinson Co.; Keweenaw Co.; Marquette; Marquette Co.; Midland Co.; Ogemaw Co.; Ontonagon Co.; Pellston (1.5 miles E.); Pontiac; St. Ignace, Mackinac Co. MINNESOTA: Bagley; Basswood Lake, Lake Co.; Duluth; International Falls; Itasca State Park; Kelliher, Beltrami Co.; Pine River; Stewart River, near Lake Superior, Lake Co.; Two Harbors; Vanhorn. NEW HAMPSHIRE: Alstead; Durham; Nelson. NEW YORK: Albany Co.; Garret Hill, Ontario Co.; Greenwood Lake; Ithaca; Keene Valley, Essex Co.; Mt. Whiteface; New Kingston, Delaware Co.; Speculator. NORTH CAROLINA: Highlands; New River. PENNSYLVANIA: Pittsburgh. *Canada.* ALBERTA: Lethbridge; Medicine Hat. MANITOBA: Aweme. NEW BRUNSWICK: Fredericton; Fundy National Park; Nerepis; St. John. NOVA SCOTIA: Cape Breton National Park; Kings Co.; Truro. ONTARIO: Arnprior; Lake of Bays (Norway Point); Muskoka; Orillia; Ottawa; Toronto. PRINCE EDWARD ISLAND: Dalvay House Canadian National Park. QUEBEC: Fort Coulonge; Hull; Kazabazua. SASKATCHEWAN: Love.

*Flower Records.* *Aster* sp., *A. azureus*, *Cirsium arvense*, *Chrysanthemum leucanthemum pinnatifidum*, *Grindelia* sp., *Helianthus strumosus*, *Hieracium aurantiacum*, *Leontodon* sp., *Rudbeckia serotina*, *Solidago* sp., *S. canadensis*, *S. gigantea leiophylla*, *S. juncea*, *Sonchus* sp., *Tanacetum vulgare*.

*Melissodes (Eumelissodes) subillata*, n. sp.

This species is closely related to *M. illata* Lovell and Cockerell, from which it can be distinguished only with some difficulty. The female of *subillata* is like *illata* in coloration and in sculpture but



FIG. 29. Map showing the known distributions of *M. (Eumelissodes) illata* Lovell and Cockerell, *M. (E.) wheeleri* Cockerell, *M. (E.) saponellus* Cockerell, and *M. (E.) appressa* LaBerge.

has the galeae more often tessellate, the mesepisterna usually shiny, and the apicomedian area of tergum 4 without minute punctures. The male of *subillata* can be distinguished from that of *illata* by the longer first flagellar segments as described below.

*Female.* Measurements and ratios: N, 20; length, 9-12 mm.; width, 3.0-4.5 mm.; wing length,  $M = 3.29 \pm 0.197$  mm.; hooks in hamulus,  $M = 12.55 \pm 0.256$ ; flagellar segment 1/segment 2,  $M = 1.98 \pm 0.033$ .

Structure and color: Integumental color as in *illata* except as follows: wing membranes usually somewhat infumate, yellowish brown; tergum 1 with apical fourth or less rufescent.

Structure and sculpture as in *illata* except as follows: galeae above usually dulled by fine tessellation in at least apical half; maxillary palpal ratio about 8.0:6.5:5.3:1.0; lateral areas of vertex with punctures usually separated by one to two puncture widths; mesoscutal punctures usually more crowded peripherally, surface only occasionally dulled by reticular shagreening; mesepisterna with punctures deep and surface usually unshagreened; tergum 1 with punctures of basal half or slightly more shallow, small, apical area and apicolateral lobes impunctate; tergum 4 with apicomedian area beneath pubescence or brown hairs impunctate and dulled as in apical areas of terga 2 and 3; terga 1-4 with apical areas opaque, dulled by dense fine reticulotransverse shagreening.

Hair: Color of vestiture as in *illata* except as follows: in general with less black or dark brown hairs; western specimens (North Dakota) paler; palest without brown on labrum and clypeus, with posteromedian mesoscutal dark patch less than twice size of scutellar dark patch, without brown on lower mesepisterna, with tergum 2 with distal white band narrowly interrupted and tergum 4 without dark brown pubescence apicomediaally; darkest specimens as in *illata* but tergum 4 with apicomedian dark area longer and less broad; usually without brown on posterior pronotal lobes, mesepisterna or labrum.

*Male.* Measurements and ratios: N, 20; length, 9-12 mm.; width, 2.5-4.0 mm.; wing length,  $M = 3.00 \pm 0.181$  mm.; hooks in hamulus,  $M = 11.20 \pm 0.247$ ; flagellar segment 2/segment 1,  $M = 5.59 \pm 0.186$ .

Structure and color: Integumental color as in *illata*. Structure as in *illata* except as follows: minimum length first flagellar segment equals one-seventh or more of maximum length second segment, flagellum reaching beyond pterostigma in repose; maxillary palpal



ratio about 7:5:5:1, fifth segment rarely present. Sculpturing as in female but terga 4 and 5 with apical areas as in 2 and 3. Terminalia as in *illata* but gonostyli not capitate or only slightly so (Figs. 99-101).

Hair: Color of vestiture as in *illata* except as follows: occasionally without brown on vertex and tegulae; mesoscutal dark patch usually about equal to scutellar in size; tergal distal white bands usually broader, that of terga 2 and 5 usually narrowly interrupted medially, but often not.

*Bionomics.* *M. subillata* is also an oligolege of the family Compositae. However, the flower data are too sparse and scattered to provide any secure hypothesis regarding generic preferences. Out of 34 collections of bees (48 females and 20 males), 28 are from composites (42 females and 18 males).

*Type Material.* Holotype female, allotype male, and eight female and six male paratypes from Ann Arbor, Michigan, were collected by L. H. Shinnars, June 17, 1952, on *Gaillardia aristosa*. One female and two male paratypes collected by L. H. Shinnars at Ann Arbor, Michigan, are as follows: 1 female and 1 male, on *Coreopsis lanceolata*, June 17, 1952; 1 male, on *Coreopsis grandiflora*, June 17, 1952. The holotype and allotype are in the Snow Entomological Museum of the University of Kansas, Lawrence. Paratypes are in the Snow Entomological Museum, the U. S. National Museum, and in the author's collection.

*Distribution.* *M. subillata* ranges from Quebec to Saskatchewan in southern Canada and south to North Carolina and Illinois in the United States (Fig. 30). It has been collected from June 1 to September 6, most often in July. In addition to the type material, 130 females and 66 males have been examined from the localities listed below.

CONNECTICUT: Colebrook; Wallingford. ILLINOIS: Carlinville; Downers Grove; Palos Park; South Maywood. INDIANA: Greenfield; Lafayette. MAINE: Lincoln Co.; South Portland; Southwest Harbor; Waldoboro. MICHIGAN: Ann Arbor; Arenac Co.; Cheboygan; Clinton Co.; Douglas Lake; East Lansing; Eaton Co.; Midland Co.; Oakland Co.; Oceana Co.; Pelee Island. MINNESOTA: Fergus Falls; Hennepin Co.; Luverne; Rock Co.; Minneapolis; Pelican Lake; Nisswa; Ramsey Co.; Sedan; University Farms, St. Paul. NEW JERSEY: Alpine; Mashipacona, Sussex Co.; Palmyra; Ramsey; Rocky Hill; Tenafly. NEW YORK: Albany; Buffalo; Flatbush; Glen Island; Ithaca; Lancaster; McLean; Pelham; Pike. NORTH CAROLINA: Ashe

Co. (Scenic Highway); Linville Falls; McDowell Co. (Blueridge Parkway); Pender; Southern Pines; Wilmington. NORTH DAKOTA: Dickinson; Fargo; Marmarth; Stanley; Tappen; Valley City. OHIO: Columbus; Franklin Co.; Lakeside, Ottawa Co. OKLAHOMA: South McAlester. SOUTH DAKOTA: Gettysburg. VERMONT: Rutland. VIRGINIA: Rocky Run, Fairfax Co.; Savannanoa. WISCONSIN: Cedar Lake, Washington Co. Canada. MANITOBA: Teulon. NOVA SCOTIA: Cape Breton National Park. ONTARIO: Brockville; Grand Bend; Jordan; Marmora; Ottawa; Pelee Point; Strathroy; Toronto. QUEBEC: Ste. Anne. SASKATCHEWAN: Love.

*Flower Records.* *Aster* sp., *A. azureus*, *Chrysanthemum leucanthemum*, *Cichorium intybus*, *Cirsium arvense*, *Coreopsis* sp., *C. grandiflora*, *C. lanceolata*, *Echinacea pallida*, *Epilobium angustifolium*, *Eupatorium maculatum*, *Gaillardia aristata*, *Helianthus maxillianus*, *H. petiolaris*, *Hieracium aurantiacum*, *Lactuca pulchella*, *Petalostemum oligophyllum*, *Platycodon grandiflorum*, *Psoralea lanceolata*, *Ratibida columnaris*, *Rudbeckia* sp., *R. hirta*, *R. laciniata*, *Solidago* sp., *S. graminifolium*, *Sonchus* sp., *S. arvensis glabrescens*, *Teucrium occidentale*, *Vernonia fasciculata*.

*Melissodes (Eumelissodes) wheeleri* Cockerell

*Melissodes wheeleri* Cockerell, 1906, Trans. Amer. Ent. Soc., vol. 32, p. 111; 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 367.

This species is very closely related to *subillata* and to *illata*. The female of *wheeleri* is like that of *subillata* in sculpture and vestiture, but is paler on the average and the fourth tergum has an apical fringe of black hairs rather than an apicomedian triangle of dark hairs. The male is like *subillata* in sculpture, but has the short first flagellar segments of *illata*. The male of *wheeleri* is distinctive in that the pale hair of the head and thorax is often ochraceous and the mandibles have yellow basal maculae.

*Female.* Measurements and ratios: N, 20; length, 10-12 mm.; width, 3.5-4.5 mm.; wing length,  $M = 3.19 \pm 0.172$  mm.; hooks in hamulus,  $M = 12.45 \pm 0.198$ ; flagellar segment 1/segment 2,  $M = 1.86 \pm 0.025$ .

Structure and color: Integumental color as in *illata* except as follows: flagellar segments 3-10 and usually apex of 2 red below; wing membranes clear. Structure and sculpture as in *illata* except as follows: supraclypeal area and lateral vertex areas usually shiny and unshagreened or delicately so; galeae above usually with delicate reticular shagreening but scarcely dull; maxillary palpal ratio

about 3.5:2.5:2.5:1.0; mesoscutum with posteromedian area punctures separated mostly by one to two puncture widths; mesepisterna usually unshagreened; metasomal terga sculptured as in *subillata*; pygidial plate as in *illata*.

Hair: Vestiture in general as in *illata* except as follows: postero-median mesoscutal dark area twice size of scutellar dark area or larger, in darkest forms thorax almost entirely black; posterior lobes of pronotum usually and upper mesepisterna often with black intermixed with white; mesepisterna with ventral, lower anterior and often lower lateral surfaces with brown hairs; tergum 1 with apical area glabrous or with sparse, minute, appressed, brown hairs basally; tergum 2 with distal white band interrupted medially; tergum 4 with apical margin fringed with black pubescence in at least median third; tergum 5 without lateral pale tufts; sternal hairs brown, occasionally pale laterally; legs as in *illata*.

*Male.* Measurements and ratios: N, 20; length, 8-11 mm.; width, 2.5-3.5 mm.; wing length,  $M = 3.10 \pm 0.185$  mm.; hooks in hamulus,  $M = 11.25 \pm 0.236$ ; flagellar segment 2/segment 1,  $M = 8.20 \pm 0.160$ .

Structure and color: Integumental color as in *illata* except as follows: labrum cream-colored with brown margin; mandibles with yellow basal maculae (often much reduced in size); flagellar segments 2-11 yellow to red below, segment 1 often red also; wing membranes clear, veins reddish brown to dark brown; terga with apical areas usually opaque, piceous or slightly rufescent except tergum 1 hyaline, in northern specimens apical areas often hyaline but infumate at least basally near pubescent bands.

Structure as in *illata* except as follows: minimum length first flagellar segment one-eighth or less of maximum length second segment; maxillary palpal ratio about 3.5:2.5:3.0:1.0, minute fifth segment occasionally present. Sculpturing as in female but tergum 1 with minute punctures to within one-fifth of apex and terga 4 and 5 similar to tergum 3. Terminalia as in *illata*.

Hair: Pale hairs often bright ochraceous or pale rufescent, dark hairs usually reddish brown. In general vestiture as in *illata* but tergum 2 with pale distal band usually broadly interrupted medially, terga 3 and 4 with pale distal bands usually narrowly interrupted, tergum 5 with pale distal band complete, and pale northern specimens with mesoscutal dark hairs reduced to a few or several.

*Variation.* Two females from Baton Rouge, Louisiana, collected by E. C. VanDyke, October 9, 1939, are quite different in having



the head and thoracic hairs almost entirely black, tergum 4 with apical dark fringe more extensive and encroaching on the distal pale band, galeae densely tessellate above, and the supraclypeal area dulled by fine tessellation. These are here considered to be merely variants of *wheeleri* and represent the darkest form from the southeastern part of the range of the species. The palest specimens are found in New Mexico, North Dakota and Minnesota and a more or less smooth cline is believed to exist between these extremes in at least the degree of melanism of the vestiture.

*Bionomics.* *M. wheeleri* is an oligolege of the family Compositae and seems to prefer the genera *Gaillardia*, *Helianthus* and *Rudbeckia* in that order. Out of 42 collections (48 females and 51 males) with flower data, 34 collections (40 females and 46 males) are from composites.

*Type Material.* Holotype female of *wheeleri* from Fedor, Lee Co., Texas, collected by G. Birkmann, May 23, 1902, is in the collection of the Museum of Natural History of the University of Colorado at Boulder.

*Distribution.* *M. wheeleri* ranges from Arizona to Louisiana and north to North Dakota and Michigan (Fig. 29). It has been collected from April 17 to October 9, but chiefly in May and June. In addition to the holotype, 64 females and 97 males have been examined from the localities listed below.

ARIZONA: Kelvin. ARKANSAS: DeQueen. KANSAS: Arkansas City; Baxter Springs; Garden City (7 miles E.); Lakin; Lawrence; Leavenworth; Reno, Leavenworth Co. LOUISIANA: Baton Rouge; Ida. MICHIGAN: Roscommon Co. MINNESOTA: Anoka Co.; Cloquet; Crystal Lake (near Robbinsdale); Detroit Lakes; Hennepin Co.; Itasca State Park; Kittson Co.; Pelican Lake; St. Anthony Park, St. Paul; Sucker Lake, Ramsey Co.; University Farm, St. Paul. MISSOURI: Meramec River (S. of State Highway 8). NEW MEXICO: Loving; Tucumcari. NORTH DAKOTA: Cannon Ball; Logging Camp, Slope Co.; Marmarth; Monango; Nicholson; Valley City. OKLAHOMA: Atoka; Claremore; South McAlester; Strang; Wagoner. TEXAS: Bastrop; Bexar Co.; Brazos Co.; Canadian; Edna; Fedor, Lee Co.; Galveston; Giddings; Goliad (and 16 miles E.); Lee Co.; McDade; Paris; Raymondsville; Robertson Co.; Sarita (21 miles S.); Weser. WISCONSIN: Cranmoor.

*Flower Records.* *Anthemis cotoula*, *Asclepias tuberosa*, *Cleome serrulata*, *Coreopsis* sp., *Echinacea* sp., *Engelmannia bipinnatifida*,

*Gaillardia* sp., *G. pulchella*, *Grindelia squarrosa*, *Helianthus* sp., *H. annuus*, *H. debilis*, *H. petiolaris*, *Opuntia* sp., *Petalostemum* sp., *P. purpureum*, *Ratibida columnaris*, *Rudbeckia* sp., *R. bicolor*, *R. grandiflora*, *R. hirta*, *Silphium asperimum*, *Sphaeralcea* sp.

*Melissodes (Eumelissodes) gelida*, n. sp.

This is a pale species of the western great plains region. It is closely related to *M. wheeleri* and *M. subillata* from which it differs primarily in the color of the vestiture. Unlike *wheeleri*, females of *gelida* have red hairs on the inner surfaces of the hind basitarsi and red wing veins. The males of *gelida* are like those of *wheeleri* but have yellow or orange wing veins and little or no brown hair on the metasomal terga.

*Female.* Measurements and ratios: N, 20; length, 10-12 mm.; width, 3.0-4.5 mm.; wing length,  $M = 3.57 \pm 0.160$  mm.; hooks in hamulus,  $M = 14.05 \pm 0.246$ ; flagellar segment 1/segment 2,  $M = 1.84 \pm 0.020$ .

Structure and color: Integumental color as in *illata* except as follows: flagellar segments 3-10 and apex of 2 red below; eyes gray to bluish gray; wing membranes clear, veins dark red; tegulae often slightly rufescent; tibial spurs white to yellow; tergum 1 usually broadly hyaline apically.

Structure and sculpture as in *illata* except as follows: clypeal punctures slightly smaller, round, often separated by one puncture width especially posteromedially; supraclypeal area with fine reticular shagreening and sparse punctures; galeae shiny, unshagreened or extremely delicately so and in less than apical half; maxillary palpal ratio about 4.5:2.0:3.0:1.0; mesoscutum with posteromedian area punctures irregular in size, some minute, separated mostly by one to three puncture widths, surface often dulled by reticular shagreening; mesepisterna with large crowded punctures, surface shiny; metasomal terga sculptured as in *subillata* and *wheeleri*; pygidial plate relatively narrow, longer than broad, apex rounded.

Hair: Head white with abundant dark brown on vertex. Thorax white except scutellum dark brown fringed with white, mesoscutum with posteromedian dark brown patch usually twice as large as scutellar dark patch (often much smaller and never extending forward at anterolateral angles to surpass level of anterior margins of tegulae); pronotum and mesepisterna without dark hairs. Metasomal tergum 1 with long white hairs basally, glabrous apically;

tergum 2 with basal area white, distal pale band white, narrow, often narrowly interrupted medially, interband zone hairs all or mostly white, erect to suberect, apical area with long, suberect to erect, white to brown (but always with some white) hairs; tergum 3 similar to 2 but basal tomentum brown and distal pale band uninterrupted; tergum 4 with apical white pubescent band often fringed at least medially with pale brown hairs; tergum 5 and usually 6 with lateral white tufts; sterna reddish brown; white laterally. Legs white except as follows: outer surfaces fore and middle tarsi, outer-apical surfaces fore and middle tibiae, and basitibial plates brown; inner surfaces fore and middle tarsi yellow to red; inner surfaces hind basitarsi dark red; inner surfaces hind tibiae yellow; scopal hairs white.

*Male.* Measurements and ratios: N, 20; length, 9-12 mm.; width, 3-4 mm.; wing length,  $M = 3.52 \pm 0.127$  mm.; hooks in hamulus,  $M = 12.80 \pm 0.213$ ; flagellar segment 2/segment 1,  $M = 7.97 \pm 0.181$ .

Structure and color: Integumental color as in *illata* except as follows: flagellum yellow below, red-brown above; labrum with mediobasal pale spot; mandibles with basal yellow spots but these occasionally reduced or absent; eyes gray to green or bluish gray; wing membranes clear, veins yellow to orange; tegulae piceous; tergal apices hyaline, colorless to yellowish, rarely slightly infumate basally.

Structure as in *illata* except as follows: minimum length first flagellar segment one-eighth or less of maximum length second segment (in allotype first equals about one-tenth of second); maxillary palpal ratio about 3.0:2.5:3.0:1.0, second often equals third. Sculpturing as in female but tergum 1 with small punctures scattered to within one-fifth of apical margin and terga 4 and 5 similar to 2. Terminalia as in *subillata*.

Hair: Head and thorax white. Metasomal tergum 1 white, subappressed long hairs usually not reaching apex medially; tergum 2 white basally, distal pale band white, narrow, often narrowly interrupted medially, interband zone and apical area with hairs long, suberect, white; terga 3-5 similar to tergum 2 but pale distal band boarder, uninterrupted, and progressively closer to apical margins; apical areas terga 2-4 occasionally pale brown in part; terga 6 and 7 white to yellow; sterna yellow medially to white at sides. Legs white except inner surfaces tarsi yellow. Long bristlelike hairs of



terga more abundant and longer than usual in *Eumelissodes* giving the metasoma a peculiar hairy look under low power.

*Type Material.* Holotype female from 15 miles south of Hyannis, Grant Co., Nebraska, collected by W. E. LaBerge, July 9, 1954, on *Ratibida* sp., is in the collection of the Snow Entomological Museum, University of Kansas, Lawrence. The allotype male from Wallace, Nebraska, collected by R. Roberts, July 3, 1933, is in the collection of the University of Nebraska, Lincoln. In addition, 18 female and 23 male paratypes from western Nebraska are as follows: Brown Co.: 3 males on *Helianthus* sp. and 1 male on *Echinacea* sp., June 21, 1902, J. C. Crawford. Glen, Sioux Co.: 5 females and 1 male, August 9, 1905; 4 females and 2 males, August 10, 1905. Haigler: 1 male, July 9, 1911 on *Helianthus petiolaris*, J. T. Zimmer; 1 female on *Ratibida columnaris*, July 10, 1911, J. T. Zimmer. Halsey: 3 males on *R. columnaris* and 1 male on *Verbena stricta*, July 11, 1909, M. H. Swenk; 1 female on *Lacinaria squarrosa*, July 25, 1912, J. T. Zimmer; 1 male, August 4, 1948, R. R. Dreisbach. Hitchcock Co.: 1 male on *Helianthus* sp., June 24, 1905. Imperial: 1 male on *H. petiolaris*, July 9, 1911, R. W. Dawson; 1 female from 8 miles N., July 9, 1954, W. E. LaBerge; 2 females and 1 male on *H. petiolaris*, July 22, 1911, R. W. Dawson. Jim Creek, Sioux Co.: 2 females and 1 male on *Helianthus* sp., July 26, 1911, M. A. Carricker, Jr. Mitchell: 1 male on *H. petiolaris*, June 30, 1913, L. M. Gates; 1 male, July 3, 1913, 1 male, July 9, 1913, L. M. Gates; 1 male on *H. petiolaris*, July 2, 1914, L. M. Gates. Monroe Canyon, Sioux Co.: 1 female on *Vernonia* sp., August 15, 1908, J. T. Zimmer; 1 male on *H. petiolaris*, July 25, 1911, R. W. Dawson; 1 female, August 7, 1913, R. W. Dawson; 1 female on *R. columnaris*, August 19, 1922, E. J. Taylor. War Bonnet Canyon, Sioux Co.: 1 male on *Argemone* sp., July 23, 1901, M. A. Carricker, Jr. Paratypes are deposited in the collections of the University of Nebraska, the Snow Entomological Museum, R. R. Dreisbach, Midland, Michigan, the U. S. National Museum, Washington, D. C. and in the author's collection.

*Bionomics.* *M. gelida* is an oligolege of composites and shows some preference for the genus *Helianthus*. Out of 37 collections (20 females and 55 males) with floral data, 32 (15 females and 30 males) are from some composite, and of these 17 collections (7 females and 14 males) are from *Helianthus*.

*Distribution.* *M. gelida* ranges from New Mexico and Texas north to Montana and North Dakota (Fig. 30). It has been collected from

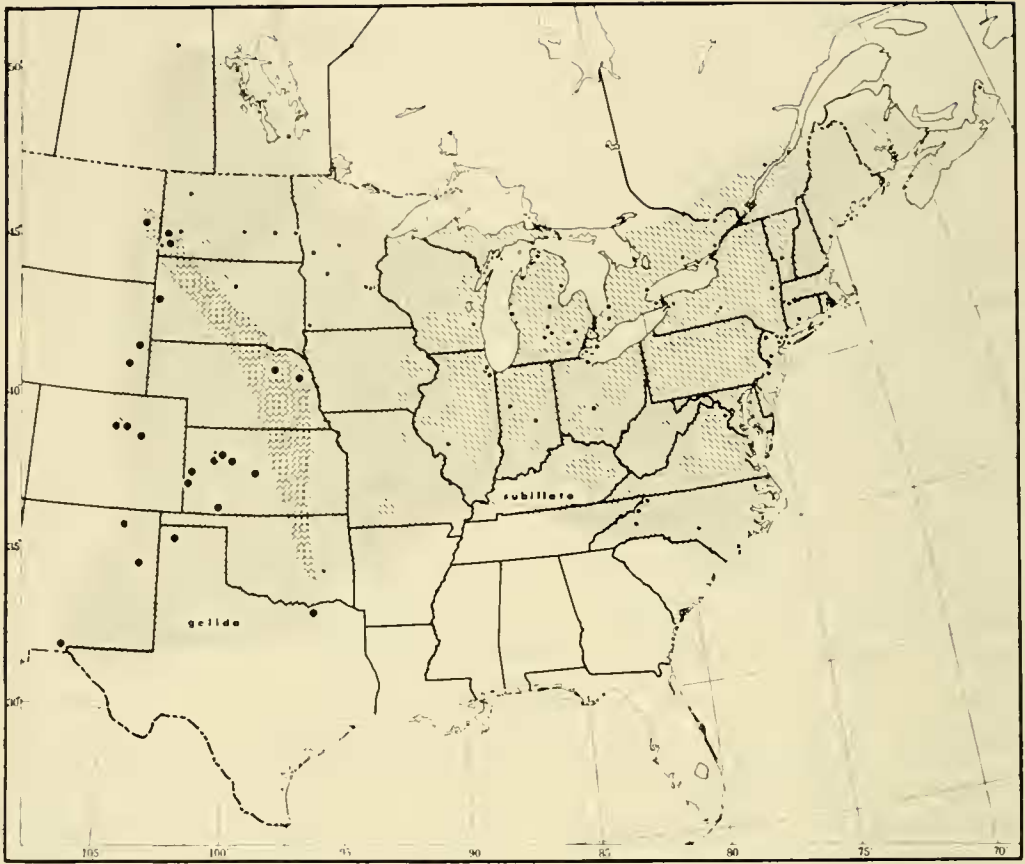


FIG. 30. Map showing the known distributions of *M. (Eumelissodes) gelida* LaBerge and *M. (E.) subillata* LaBerge.

June 3 to August 19, but chiefly in June and July. In addition to the type material, 24 females and 49 males have been examined from the localities listed below (this list does not include the type localities of western Nebraska listed above).

COLORADO: Berkley; Boulder; Brighton; Deer Trail; White Rocks (Valmont). KANSAS: Gove Co.; Great Bend; Hamilton Co.; Meade County State Park; Pierceville; Quinter (5 and 9 miles N.); Trego Co.; Tribune (10 miles E.). MONTANA: Glendive. NEBRASKA: Neligh; West Point. NEW MEXICO: Maxwell; Mesilla; Tucumcari. NORTH DAKOTA: Logging Camp Ranch, Slope Co.; Medora. SOUTH DAKOTA: Custer. TEXAS: Bonham; Dalhart. WYOMING: Lusk; Wheatland.

*Flower Records.* *Argemone* sp., *Chrysopsis* sp., *Cosmos* sp., *Echinacea* sp., *Engelmannia pinnatifida*, *Gaillardia* sp., *Helianthus* sp., *H. annuus*, *H. petiolaris*, *Lacinaria squarrosa*, *Monarda pectinata*, *Ratibida* sp., *R. columnaris*, *Sphaeralcea* sp., *Thelesperma gracile*, *Verbena stricta*, *Vernonia* sp.

*Melissodes (Eumelissodes) subagilis* Cockerell

- Melissodes agilis* var. *subagilis* Cockerell, 1905, Entomologist, vol. 38, p. 145; 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 367; 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 76, 92; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 137; Cockerell, 1923, Ent. News, vol. 34, p. 46; 1925, Ann. Mag. Nat. Hist., ser. 9, vol. 16, p. 229; Brimley, 1938, Insects of North Carolina, p. 462.
- Melissodes pecosella* Cockerell, 1905, Proc. Biol. Soc. Washington, vol. 18, p. 179 (new synonymy); 1906, Trans. Amer. Ent. Soc., vol. 32, p. 88; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309; 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 366; 1928, Univ. Colorado Studies, vol. 16, p. 114; Cresson, 1928, Mem. Amer. Ent. Soc., vol. 5, p. 69.
- Tetraloniella excurrens melanaspis* Cockerell, 1925, Ann. Mag. Nat. Hist., ser. 9, vol. 16, p. 228 (new synonymy); Hicks, 1926, Univ. Colorado Studies, vol. 15, p. 225; Cockerell, 1928, Univ. Colorado Studies, vol. 16, p. 114.
- Xenoglossodes albertensis* Cockerell, 1937, Canadian Ent., vol. 69, p. 87 (new synonymy).

This small species is the first of a series of small pale western species related to the *coreopsis* group. The female of *subagilis* differs from that of *coreopsis* in its pale color, broader distal pale bands of terga 2 and 3, and small size. The male of *subagilis* is very similar to that of *coreopsis* but has the first flagellar segment longer, a broader distal pubescent band on tergum 2, more distinctly punctate terga, and smaller size.

*Female.* Measurements and ratios: N, 20; length, 9-12 mm.; width, 3.5-4.5 mm.; wing length,  $M = 2.88 \pm 0.185$  mm.; hooks in hamulus,  $M = 11.85 \pm 0.194$ ; flagellar segment 1/segment 2,  $M = 1.94 \pm 0.035$ .

Structure and color: Integument black except as follows: mandibles, legs (at least tarsi) and apical third of tergum 1 usually rufescent; flagellar segments 3-10 and usually apical third or more of 2 yellow to red below, dark brown above; eyes usually blue, occasionally gray or greenish blue; wing membranes clear, veins often dark red, usually reddish brown to black; tegulae piceous, often rufescent above; tibial spurs white to yellowish.

Structure of clypeus as in *coreopsis*; clypeal punctures round, coarse, separated mostly by half a puncture width or less, surface slightly dulled by reticular shagreening; supraclypeal area shiny, unshagreened or delicately so; galeae above usually dulled by dense tessellation in at least apical half; lateral areas of vertex with punctures separated mostly by two to three or more puncture widths, surface shiny; maxillary palpal ratio about 3:2:2:1, rarely a minute fifth segment present. Mesoscutal punctures round, deep, large, peripherally separated by half to one puncture width, posteromedially by two to four widths, often with small posteromedial impunctate area, surface shiny; scutellum similar but punctures



more crowded; mesepisterna with punctures large, deep, separated by half a puncture width or less, surface shiny. Metasomal tergum 1 with round shallow punctures in basal half or slightly more separated by half to one puncture width, apical area impunctate, surface dulled basally by coarse reticulotransverse shagreening, apically less dull, shagreening finer; tergum 2 with basal area punctures separated mostly by one to two puncture widths, shiny, interband zone with small sparse punctures separated mostly by two or more puncture widths and of irregular size, surface dulled as in base of tergum 1, apical area impunctate, relatively shiny; terga 3 and 4 similar but interband zone punctures more abundant and apical area usually absent; pygidial plate with rounded apex, longer than broad.

Hair: Head pale ochraceous to white, usually with brown at vertex but usually not abundant. Thorax white laterally to ochraceous above; scutellum often brown with ochraceous peripherally, occasionally entirely pale; mesoscutum in eastern and northern specimens usually with no brown hairs posteromedially or with less than on scutellum, in the southwestern states usually with abundant brown posteromedially but dark patch rarely as much as twice scutellar dark area in size; anterior mesoscutal hairs decumbent; appressed to subappressed. Metasomal tergum 1 with pale ochraceous hairs basally, glabrous apically; tergum 2 white basally, distal pale band pale ochraceous to white, broader than apical apubescent area medially, rarely interrupted medially, apical hairs of pale band relatively simple and about as long as more basal plumose hairs, interband zone hairs short, subappressed to suberect, mostly or entirely ochraceous; tergum 3 similar but basal tomentum brown, distal pale band reaches apex of tergum in at least lateral thirds and usually across entire tergum, tergum 4 with distal pale band apical, white to pale ochraceous, uninterrupted; tergum 5 with broad lateral pale tufts; tergum 6 brown to orange-brown with lateral pale tufts; sterna orange-brown medially to white apicolaterally, white across apex of penultimate sternum. Legs white to pale ochraceous except as follows: outer surfaces fore and middle tibiae brown; inner surfaces hind basitarsi yellow to red in eastern specimens, red to dark reddish brown in western specimen; scopae white.

*Male.* Measurements and ratios: N, 20; length, 8-11 mm.; width, 2.0-3.5 mm.; wing length,  $M = 2.70 \pm 0.196$  mm.; hooks in hamulus,  $M = 10.95 \pm 0.235$ ; flagellar segment 2/segment 1,  $M = 6.65 \pm 0.183$ .

Structure and color: Integument black except as follows: clypeus yellow except testaceous apical margin and tentorial pits dark; labrum without mediobasal pale spot; mandibles without basal pale spots; flagellum yellow to red beneath, dark red to brown above, segment 1 occasionally entirely brown; eyes usually blue or greenish blue, occasionally gray or yellowish gray; wing membranes clear, veins yellow to dark red, rarely brown; tegulae, tibial spurs, tarsi as in female; terga with apical areas hyaline, colorless to slightly yellowed.

Structure of clypeus as in *coreopsis*; minimum length first flagellar segment equals one-fifth to one-eighth maximum length of second segment, rarely as short as one-tenth second segment, minimum length first segment usually equals more than half its own maximum, flagellum in repose reaching pterostigma, penultimate segment more than three times as long as broad; maxillary palpal ratio about 4.0:3.5:3.0:1.0, minute fifth segment rarely present. Sculpture as in female except as follows: galeae above often only delicately shagreened in apical half or shiny and unshagreened, occasionally densely tessellate as in female; clypeal punctures smaller; tergum 1 with punctures more crowded basally, with small punctures scattered almost to apical margin; tergum 2 with interband zone punctures larger, separated mostly by two puncture widths; terga 3-5 similar to 2, but apical areas progressively shorter. Terminalia as in *agilis*, sternum 8 with ventral tubercle with apex bidentate (Figs. 102-104).

Hair: Head usually ochraceous, occasionally white (especially in western specimens). Thorax white to pale ochraceous laterally, ochraceous dorsally (white dorsally in western specimens), without brown. Metasomal tergum 1 with long white to ochraceous hairs, near apex hairs appressed and surpassing margin but not highly branched and not hiding margin except at extreme sides; tergum 2 with distal pale band usually longer medially than apical apubescent area, apical area with long, relatively simple, white to yellow, subappressed to suberect hairs, without brown; terga 3-5 similar but distal pubescent band progressively closer to apex until tergum 5 without apical area; terga 6 and 7 dark ochraceous to white; sterna yellowish medially to white laterally. Legs white to pale ochraceous except inner surfaces tarsi yellow.

*Geographical Variation.* The populations from east of the continental divide from North Dakota to New Mexico can be separated in the female sex from those west of the divide. The eastern popu-

lations have females with the pale vestiture primarily ochraceous, with hairs of the inner hind basitarsi orange to red, and with the wing veins reddish brown. From west of the divide females usually have the pale vestiture white, have dark brown wing veins, and the hairs of the inner surfaces hind basitarsi dark reddish brown to almost black. Some exceptions to this distribution of characters occur. A number of females from Utah have pale yellow wing veins and yellowish orange hairs on inner surfaces hind basitarsi.

In the respects listed above about half of the females from Arizona are in the western group, slightly less than half are of the eastern type, and a few intermediates occur. Intermediates occur also in the few specimens available from Alberta, Canada. The remaining females from Alberta are typically eastern except the holotype female of *albertensis* which is of the western type. The name *albertensis* has priority over other available names and would thus apply as a subspecific name for the populations west of the continental divide. The Alberta and Arizona populations would be considered as intermediate groups between the subspecies.

The Arizona females, especially, and some Utah and New Mexico females have dark brown hairs on the mesoscutum. This is rare in the more northern populations. A third subspecies could thus be recognized and, perhaps, a fourth in the southern areas of the range.

The males cannot be so neatly classified into geographic races as the females. The western populations are on the average paler in color, but this characteristic is not reliable as many specimens become faded with age. There are males from Utah which have pale yellow wing veins and flagella from the same localities, in some cases, as the females mentioned above. These are probably much faded specimens in both sexes.

This author is not formalizing the geographic races of *subagilis* with subspecific names because of the nature of the characteristics involved, that is, color which is liable to fading with age, because only one sex is involved, and because one character (dark mesoscutal patch) is not concordant with the others.

*Bionomics.* Hicks (1926) has described a nesting female of this species found in Colorado (as *Tetraloniella excurrens melanaspis*). The entrance to the burrow was found on level ground in a stand of rattlesnake grass. A female was seen entering and, after a wait of twenty minutes, the nest was excavated. The burrow went straight



into the ground for three inches but no pollen or cell was found at the bottom. This was probably a nest which had only been begun.

*M. subagilis* is an oligolege of the composite genus *Grindelia*. This is clearly indicated by the floral data accompanying specimens which is summarized in Table XVI.

*Type Material.* The male holotype of *agilis subagilis* from Fort Collins, Colorado, is in the collection of Prof. P. H. Timberlake, Citrus Experiment Station, Riverside, California. The holotype female of *pecosella* from Pecos, New Mexico, collected by W. P. Cockerell, is in the collection of the Philadelphia Academy of Sciences, Philadelphia, Pennsylvania. The holotype female of *Tetraloniella excurrens melanapsis* from Wray, Colorado, collected by F. E. Lutz, August 17-18, 1919, is in the collection of the American Museum of Natural History, New York City. The holotype female

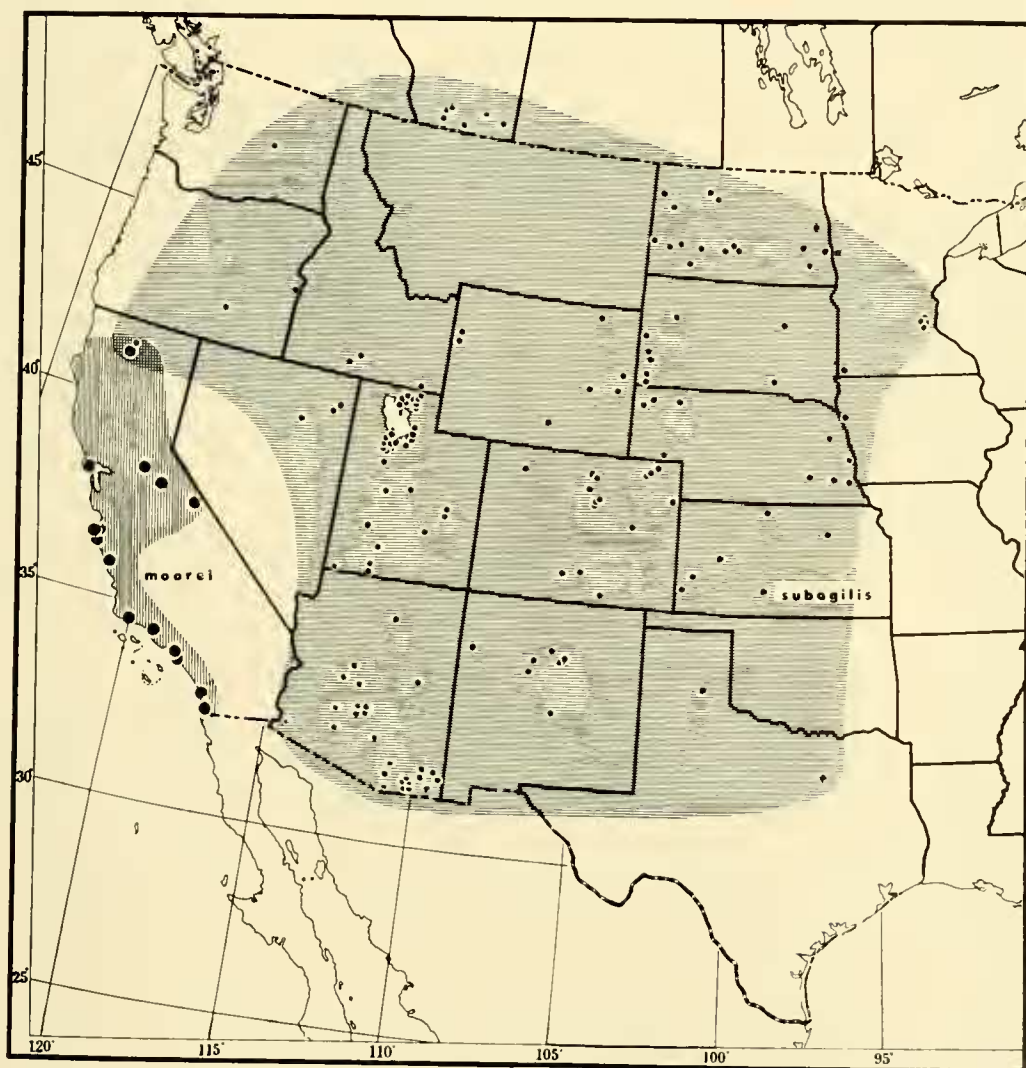


FIG. 31. Map showing the known distributions of *M. (Eumelissodes) subagilis* Cockerell and *M. (E.) moorei* Cockerell.

of *Xenoglossodes albertensis* from Milk River, Alberta, Canada, collected by W. P. Cockerell, is in the American Museum of Natural History, New York City.

*Distribution.* *M. subagilis* ranges from northern California, north to Alberta, Canada, east to Minnesota and Iowa, and south to Texas and New Mexico (Fig. 31). It is primarily a Great Plains and Intermontane Region species. It has been collected from June 6 to November 3, but chiefly in July, August and September. In addition to the type material, 455 females and 348 males have been examined from the localities listed below (including the type localities).

TABLE XVI. Summary of Floral Data for *Melissodes subagilis*.

Plant Data			Records of <i>M. subagilis</i>			
FAMILY	Number of genera	Number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae: <i>Grindelia</i> spp.	1	2	59	131	81	212
<i>Aster</i> spp.	1	2	8	18	5	23
<i>Helianthus</i> spp.	1	3	11	6	6	12
Other genera	15	20	34	41	37	78
Other families (4)	7	7	10	6	14	20
Totals	25	34	119	202	143	345

ARIZONA: Arlington; Bisbee (10 and 18 miles W.); Carr Canyon, Huachuca Mts.; Chandler Heights; Chiricahua Mts.; Congress Junction; Continental; Douglas (8 miles N. E.); Faraway Ranch; Hereford; Holbrook; Laveen, Moencopi Wash; Nogales; Pearce; Pedersons Ranch (road to), Huachuca Mts.; Phoenix; Picacho Pass; Portal (1 mile W.); Prescott; Ramsey Canyon, Huachuca Mts.; Rock Springs, Yavapai Co.; Sonoita (10 miles E.); Tempe; Theba; Tombstone (4 miles N.W.); Tucson; Turner; Willcox; Yuma. CALIFORNIA: Gazelle, Siskiyou Co. COLORADO: Boulder; Craig; Crook; Denver; Fort Collins; Hoehnes (N. E. of); Limon; Logan Co.; Red Wash; San Luis Valley; Sterling; Timnath; Utah Junction; Wray. IDAHO: Franklin; Hazelton (3 miles N. E.);

Twin Falls. IOWA: Sioux City. KANSAS: Cullison; Johnson (2 miles N.), Stanton Co.; Lakin (4 miles E.); Lane Co.; Riley Co.; Smith Co. MINNESOTA: Luverne; Moorhead; Powder Plant Woods, Ramsey Co.; Ramsey Co.; St. Paul; University Farm, St. Paul. NEBRASKA: Crawford; Glen, Sioux Co.; Gordon, Sheridan Co.; Lincoln; Lodgepole; McCool Junction; Nebraska City; Omaha; West Point. NEVADA: Elko; Pequop (Summitt) Wells, Elko Co. NEW MEXICO: Albuquerque; Algodones; Gallup; Rowe; San Jose; Santa Fe; Tecolote. NORTH DAKOTA: Belfield; Bismarck; Carpio; Dickinson; Fargo; Glen Ullin; Hatton; Lisbon; Mandan; McKenzie; Minot; Mott; Schafer; Sentinel Butte; Valley City; Williston. OREGON: Ontario; Silver Lake. SOUTH DAKOTA: Ardmore; Cedar Canyon, Badlands; Custer; Deadwood; Hill City (8 miles N.); Hot Springs; Platte; Redfield. TEXAS: Clarendon; Dallas; Fabens. UTAH: Bear River City; Beaver; Benson; Bert; Cache Junction; Collinston; Delta; Elgin; Ephraim; Erda; Farmington; Fort Hall; Garfield; Garland; Glendale; Granite Peak, Dugway Proving Ground, Tooele Co.; Grantsville; Green River; Hanksville (10 miles S.); Hatch; Iosepa; Johnson; Kaysville; Lake Point; Lampo; Logan; Logan Canyon; Payson; Petersboro; Promontory; Saltair Beach; Salt Lake City; Santa Clara; Simpson Springs, Dugway Proving Ground, Tooele Co.; Skull Valley; Smelter; Delle; Timpie; Tooele. WASHINGTON: Coulee City. WYOMING: Carbon Co.; Douglas; Flat Creek; Jackson Hole; Niobrara Co. (northern part); North Campbell Co.; Old Woman Creek, Niobrara Co. *Canada*. ALBERTA: Lethbridge; Magrath; Medicine Hat; Milk River; Scandia; Welling.

*Flower Records.* *Aplopappas* sp., *A. gracilis*, *A. spinulosus*, *A. tenuisectus*, *Aster* sp., *A. adscendus*, *Baccharis* sp., *Baileya* sp., *B. multiradiata*, *Bigelovia wrightii*, *Chrysopsis* sp., *C. hispida*, *Chrysothamnus* sp., *C. viscidiflorus*, *Cleome* sp., *C. serrulata*, *Eri-geron* sp., *Gossypium herbaceum*, *Grindelia* sp., *G. nana*, *G. squarrosa*, *Gutierrezia sarothrae*, *Helianthus* sp., *H. annuus*, *H. maximilianus*, *H. petiolaris*, *Heterotheca subaxillaris*, *Isocoma acradenia*, *Medicago sativa*, *Pectis papposa*, *Petalostemum* sp., *Prionopsis ciliata*, *Ratibida tagetes*, *Salsola pestifer*, *Silphium* sp., *Solidago* sp., *S. rigida*, *S. serotina*, *Sphaeralcea* sp., *Verbena hastata*, *Verbesina* sp., *V. exauriculata*.

*Melissodes (Eumelissodes) limbus*, n. sp.

This is a small species from southwestern United States and Mexico. It is related to *subagilis*, although not closely. Both male and female of *limbus* are unlike *subagilis* in that the apical



areas of the terga have short, brown, relatively simple, subappressed to suberect hairs.

*Female.* Measurements and ratios: N, 20; length, 9-11 mm.; width, 3-4 mm.; wing length,  $M = 2.83 \pm 0.111$  mm.; hooks in hamulus,  $M = 11.90 \pm 0.164$ ; flagellar segment 1/segment 2,  $M = 1.99 \pm 0.024$ .

Structure and color: Integument as in *subagilis* except as follows: eyes blue; wing veins dark brown to black; tegulae often rufescent.

Structure and sculpture as in *subagilis* except as follows: clypeal punctures irregular in size, larger posteriorly, separated mostly by half a puncture width, apicomedian carina often broad and punctate, surface shiny, with no or extremely delicate shagreening; supraclypeal area punctate, shiny; galeae above shiny, unshagreened except near tips; maxillary palpal ratio about 4.0:2.5:2.5:1.0. Mesoscutal punctures small, round, peripherally separated by half to one and posteromedially by half to three puncture widths, surface shiny, unshagreened or delicately so; mesepisternal punctures separated by less than half to one puncture width, mostly by about one-half. Metasomal tergum 1 with shallow punctures in basal three-fifths separated mostly by half to one puncture width; tergum 2 with basal area punctures small, separated mostly by one puncture width or less, interband zone punctures minute, shallow, separated by one to three puncture widths, apical area with sparse minute punctures no more than twice width of hairs arising from them, surface moderately shiny to shiny; tergum 3 similar to 2 but apical area punctures reduced to one or two rows just apical to distal white band; tergum 4 similar but apical area absent; pygidial plate V-shaped, not much rounded apically, longer than broad.

Hair: Head white except vertex with relatively sparse long brown hairs (absent in allotype). Thorax white laterally; mesoscutum white to pale ochraceous except posteromedial brown patch which extends forward to a transverse line at about middle of tegulae; scutellum dark brown medially, white peripherally; tegulae without brown. Tergum 1 white basally, glabrous apically except at extreme sides; tergum 2 white basally, distal pale band white, as long as apical apubescent area medially, usually not interrupted medially, although usually thinned, interband zone hairs short, simple, subappressed to suberect, dark brown, apical area with similar hairs but longer; tergum 3 similar to 2 but distal pale band broader and apical area shorter, apical brown hair fringe often worn away; tergum 4 with distal white band apical, uninterrupted;

terga 5 and 6 dark brown medially, with distinct white lateral tufts; sterna reddish brown medially to white laterally, penultimate sternum white apically. Legs white except as follows: outer surfaces fore tarsi and outer apical surfaces fore and middle tibiae light brown; basitibial plate brown; inner surfaces basitarsi yellow to red; inner surfaces hind tibiae yellow.

*Male.* Measurements and ratios: N, 20; length, 9-11 mm.; width, 2.5-3.5 mm.; wing length,  $M = 2.86 \pm 0.138$  mm.; hooks in hamulus,  $M = 11.05 \pm 0.198$ ; flagellar segment 2/segment 1,  $M = 9.00 \pm 0.286$ .

Structure and color: Integument color as in *subagilis* except as follows: base of mandibles (holotype) occasionally with yellow spots; labrum occasionally with mediobasal yellow spots; flagellar segment 1 yellow; wing veins red to reddish brown; tegulae usually testaceous.

Structure as in *subagilis* except as follows: minimum length first flagellar segment equals one-tenth maximum length second segment and usually half of its own maximum length, flagellum reaches middle of submarginal cell or beyond in repose; maxillary palpal ratio about 3.0:2.5:2.5:1.0. Sculpture as in female except as follows: tergum 1 with scattered minute punctures to within one-sixth of apical margin; terga 2 and 3 with apical areas impunctate; terga 3-5 with interband zones with distinct round punctures separated by one puncture width or less, with apical areas progressively shorter. Terminalia as in *agilis*, sternum 8 with tubercle bidentate apically.

Hair: Head white. Thorax white laterally; white to pale ochraceous dorsally; scutellum and mesoscutum without brown. Tergum 1 usually white to pale ochraceous, apically with shorter, relatively simple, appressed to subappressed, pale hairs reaching or surpassing apical margin but not obscuring apical area except at extreme sides; terga 2-7 as in *subagilis* except as follows: 2 and 3, often 4, with apical areas with short, relatively simple, subappressed to suberect, pale to dark brown hairs, terga 4 and 5 occasionally with pale brown in interband zones, and terga 6 and 7 ochraceous to pale brown. Sterna and legs as in *subagilis*.

*Bionomics.* This species is an oligolege of composites and seems to prefer the genera *Verbesina*, *Aplopappus*, and *Baileya* in that order. However, the available floral data are not complete enough to make a more precise statement of preference. It is worthy of remark that *M. limbus* has not yet been collected on *Helianthus*,

a genus frequented by most *Eumelissodes*. Also, large numbers, mostly males, have been taken on *Melilotus alba* at the American Museum of Natural History Southwest Research Station near Portal, Arizona.

*Type Material.* The holotype male and nineteen male paratypes from 10 miles south of Tucson, Arizona, collected by C. D. Michener, August 7, 1940, on *Verbesina* sp., are in the Snow Entomological Museum of the University of Kansas, Lawrence. The allotype female from Tucson, collected by G. D. Butler, May 14, 1955, on *Baileya multiradiata*, is in the collection of the University of Arizona at Tucson. In addition to the above, 18 female and 42 male paratypes from Tucson, Arizona, or the immediate vicinity, are as follows: 1 male, October 2-25, 1916; 1 female, September, 1930, Frances Hamilton; 1 female, September 16, 1932, R. A. Flock; 1 female, April 1, 1934, Bryant; 1 male, August 17, 1937, R. H. Crandall; 1 male on *Sphaeralcea* sp. and 25 males on *Verbesina exauriculata*, August 7, 1940, P. H. Timberlake; 2 males, August 7, 1940, C. D. Michener; 6 males, August 7, 1940, E. S. Ross; 1 male, April 27, 1951, K. L. Dyre; 1 female on desert marigold and 1 female without floral data, May 11, 1953, G. D. Butler; 2 females and 1 male, May 12, 1953, G. D. Butler; 1 female, May 28, 1953, G. D. Butler; 2 females on *Verbesina* sp., May 29, 1953, G. D. Butler; 1 female, October 4, 1953, G. D. Butler; 1 female on *Aplopappus* sp., May 30, 1954, F. G. Werner; 1 male on *Aplopappus* sp., September 26, 1954, F. G. Werner; 3 females on *Encelia farinosa* and 1 female on *Baileya* sp., G. D. Butler, April 24, 1955; 3 males on *Argemone* sp., F. G. Werner and G. D. Butler, August 24, 1955; 2 females on *Baccharis* sp., October 14, 1955, G. D. Butler. Paratypes are deposited in the collections of P. H. Timberlake, Citrus Experiment Station, Riverside, California, the University of Arizona, the Snow Entomological Museum, the California Academy of Sciences, San Francisco, the U. S. National Museum in Washington, D. C. and in the author's collection.

*Distribution.* *M. limbus* ranges from Arizona, southern New Mexico and Texas to Jalisco in Mexico (Fig. 32). It has been collected from April 1 to October 25 with seemingly two peaks of abundance in May and in August. In addition to the type material, 70 females and 161 males have been examined from the localities listed below (the list includes the type locality).

ARIZONA: Apache; Bisbee (10 miles N. W.); Chiricahua Mts.; Continental; Cortaro; Douglas; Drake; Elfrida; Emery Park; Flag-



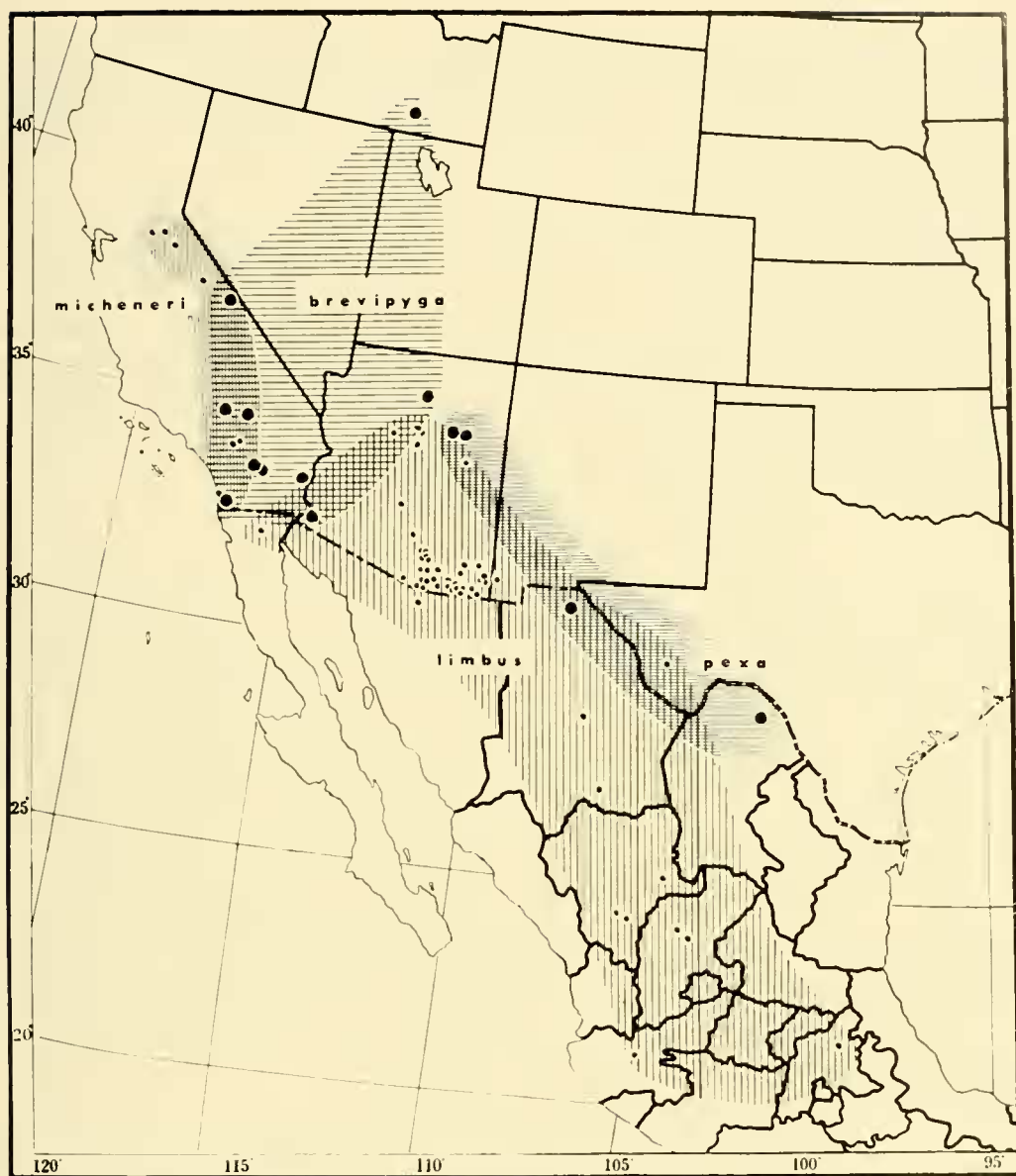


FIG. 32. Map showing the known distributions of *M. (Eumelissodes) limbus* LaBerge, *M. (E.) pexa* LaBerge, *M. (E.) brevipyga* LaBerge, and *M. (E.) micheneri* LaBerge.

staff; Hereford; Huachuca Mts.; Madera Canyon, Santa Rita Mts.; Marana; Nogales; Oak Creek Canyon; Patagonia; Pearce; Petersons Ranch, Huachuca Mts.; Phoenix; Picacho Pass, Pinal Co.; Portal; Ramsey Canyon, Huachuca Mts.; Rillito (12 miles W. on Silverbelt Road); Sahuarita; Santa Rita Mts.; Sasabe; Sedona; Snowflake; Sonoita; Southwest Research Station (5 miles W. of Portal); Sycamore Canyon, Tumacacori Mts.; Tombstone; Tucson; Turner; Vail; Warren; Willcox (2.5 miles S.). NEW MEXICO: Rodeo (10 miles N.), San Simon Valley, Hidalgo Co. TEXAS: Marfa. MÉXICO. BAJA CALIFORNIA: Big Canyon, Sierra Laguna. CHIHUAHUA:

Charcos, Allende District; Chihuahua. DURANGO: Durango; Nombre de Dios; Palos Colorados; Rodeo (12 miles N.); Yerbanis, Cuencamé District. HIDALGO: Actopán. JALISCO: Lagos de Moreno (15 miles N. E.). SONORA: Imuris (12 miles N.). ZACATECAS: Fresnillo; Sain Alto.

*Flower Records.* *Aplopappus* sp., *A. gracilis*, *A. spinulosus*, *A. tenuisectus*, *Argemone* sp., *Aster* sp., *Baccharis* sp., *Baileya* sp., *B. multiradiata*, *Chrysothamnus* sp., *Encelia farinosa*, *Eriogonum* sp., *Gossypium herbaceum*, *Grindelia* sp., *Gutierrezia* sp., *Hymenothrix wislizenii*, *Kallstroemia grandiflora*, *Marrubium vulgare*, *Melilotus alba*, *Pectis papposa*, *Sphaeralcea* sp., *Verbesina* sp., *V. encelioides*, *V. exauriculata*, *Wedeliella incarnata*.

*Melissodes (Eumelissodes) rufipes*, n. sp.

This is a Mexican species which is extremely closely allied to *M. subagilis* of the United States. Indeed, it may prove to be no more than a well-marked geographical race of *subagilis*, but it is here treated as a distinct species until additional evidence clarifies the matter. The female of *rufipes* is similar to that of *subagilis* but is slightly larger, has brown on the mesoscutum and scutellum, and has the distal pale band of tergum 2 narrowly interrupted medially. The male is like that of *subagilis* but has the galeae usually shiny and only slightly shagreened if at all. Both sexes of *rufipes* differ from the typical *subagilis* in that the hair of the head and thorax is longer and more erect, that on the vertex of the male being longer than the third flagellar segment.

*Female.* Measurements and ratios: N, 20; length, 10-13 mm.; width, 3.5-4.5 mm.; wing length,  $M = 3.25 \pm 0.140$  mm.; hooks in hamulus,  $M = 12.90 \pm 0.176$ ; flagellar segment 1/segment 2,  $M = 2.00 \pm 0.025$ .

Structure and color: Integumental color as in *subagilis* except as follows: apical half of mandible, distitarsi and apical margin of tergum 1 rufescent; flagellar segments 3-10 dark red below, black above, apex of segment 2 occasionally red below, base of segment 3 often red below (allotype); eyes yellowish gray to greenish gray; wing veins dark reddish brown; tegulae black.

Structure and sculpture as in *subagilis* except as follows: clypeus and usually supraclypeal area with surface somewhat dulled by tessellation; galeae reticularly shagreened above in apical half or more, usually shiny basally; maxillary palpal ratio about 4.0:3.5:3.0:1.0. Mesoscutal surface often (allotype) dulled by reticular

shagreening posteromedially; scutellar punctures smaller and more crowded; mesepisternal punctures equal to posteromedial mesoscutal punctures and separated mostly by less than half a puncture width. Metasomal tergum 1 with basal three-fifths with shallow crowded punctures separated mostly by half a puncture width, apical area impunctate; tergum 2 with basal area punctures separated mostly by one puncture width or less, interband zone punctures minute, separated mostly by one to two puncture widths.

Hair: Color of vestiture as in eastern forms of *subagilis* except as follows: vertex of head with abundant black; scutellum and mesoscutum with black, dark mesoscutal area twice size of scutellar dark area or smaller; tergum 2 with distal pale band usually narrowly interrupted medially; terga 5 and 6 golden to light brown medially and white to ochraceous laterally; legs with inner surfaces hind basitarsi red to orange-yellow. Hairs of head and thorax longer than in *subagilis*; those on anterior part of mesoscutum tend to be erect rather than decumbent as in *subagilis*.

*Male.* Measurements and ratios: N, 18; length, about 11 mm.; width, about 3.5 mm.; wing length,  $M = 3.19 \pm 0.247$  mm.; hooks in hamulus,  $M = 11.56 \pm 0.217$ ; flagellar segment 2/segment 1,  $M = 5.93 \pm 0.154$ .

Structure and color: Integumental color as in *subagilis* except as follows: eyes yellowish gray to greenish gray; first flagellar segment (holotype) usually entirely brown.

Structure as in *subagilis* except as follows: maxillary palpal ratio about 4.0:3.0:2.5:1.0. Sculpture as in female except as follows: galeae above only delicately shagreened and often only in apical third (holotype) or less; tergum 1 punctate to within one-sixth of apical margin medially, punctures separated mostly by one to two puncture widths; terga 3-5 similar to 2 but apical areas progressively shorter. Terminalia as in *agilis* but sternum 8 with ventral tubercle lamellate with apex acute.

Hair: Vestiture color as in *subagilis* except as follows: in general pale ochraceous; scutellum medially and mesoscutum posteromedially occasionally with brown hairs (not in holotype); tergum 2 with distal pubescent band usually shorter medially than apical apubescent area (subequal in holotype). Hairs of head and thorax longer than in *subagilis*; those of vertex of head usually distinctly longer than flagellar segment 3; those of anterior part of mesoscutum erect to suberect rather than decumbent as in *subagilis*.



*Type Material.* Holotype male, allotype female, and 21 female and 2 male paratypes from Pachuca, Hidalgo, México, were collected by the University of Kansas Mexican Expedition, June 24, 1953. The holotype and allotype are in the Snow Entomological Museum of the University of Kansas, Lawrence. Paratypes are in the Snow Entomological Museum, the U. S. National Museum, Washington, D. C., and in the author's collection. In addition to the above, four female paratypes from Pachuca, Hidalgo, México, July 28, 1954, and one female and four male paratypes from Actopán, Hidalgo, México, July 29, 1954, were collected by the University of Kansas Mexican Expedition of 1954.

*Distribution.* *M. rufipes* ranges through northern Mexico from Chihuahua to Coahuila and south to Hidalgo and Aguascalientes. It has been collected from June 24 to August 21. In addition to the type material, 11 females and 9 males were examined. Localities of these and of the types are listed below.

AGUASCALIENTES: Aguascalientes; Rincon de Romos. CHIHUAHUA: Matachic (2 miles W.); Parrita (19 miles S.). COAHUILA: Cabos. DURANGO: Durango (and 18 miles S.); Nombre de Dios. HIDALGO: Actopán; Pachuca.

*Melissodes (Eumelissodes) humilior* Cockerell

*Melissodes humilior* Cockerell, 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 12, p. 447; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 87; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 309; 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 286. *Melissodes intermedia*, Cockerell (misidentification), 1898, Bull. Sci. Lab. Denison Univ., vol. 11, p. 67; 1898, Bull. Univ. New Mexico, vol. 1, p. 67; 1903, Ann. Mag. Nat. Hist., ser. 7, vol. 12, p. 450. *Melissodes intermediella* Cockerell, 1905, Bull. S. California Acad. Sci., vol. 4, p. 102 (new synonymy); 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 88, 92; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 310; 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 366; Snow, 1906, Trans. Kansas Acad. Sci., vol. 20, p. 137.

This is a small species closely related to *M. limbus*. The female of *humilior* can be distinguished from that of *limbus* by the broader apical areas of terga 2 and 3 (with dark hairs as in *limbus*), the darker hairs of the inner surfaces of the hind basitarsi, the darker wing veins, and the shagreened galeae. The male of *humilior* can be told from that of *limbus* principally by the large basal triangular yellow spots of the mandibles and the large pale mediobasal labral spot.

*Female.* Measurements and ratios: N, 20; length, 9-11 mm.; width, 3-4 mm.; wing length,  $M = 2.75 \pm 0.197$  mm.; hooks in hamulus,  $M = 12.00 \pm 0.205$ ; flagellar segment 1/segment 2,  $M = 1.97 \pm 0.035$ .

Structure and color: Integumental color as in *subagilis* except as follows: tergum 1 extremely narrowly hyaline apically, not much rufescent if any; wing veins dark brown to black. Structure and sculpture as in *subagilis* except as follows: clypeus with surface often coarsely shagreened, dull; supraclypeal area usually dulled by reticular shagreening or fine tessellation in apical half or more; maxillary palpal ratio about 3.5:2.5:2.5:1.0, posteromedian meso-scutal punctures usually separated by one to two puncture widths, rarely with subimpunctate area, surface shiny, delicately or not at all shagreened; tergum 1 with basal three-fifths with large shallow punctures separated mostly by less than one puncture width; tergum 2 with basal area punctures separated mostly by half to one puncture width, interband zone with distinct punctures separated mostly by one to two puncture widths, apical area with minute punctures equal to no more than twice diameter of hairs arising from them; pygidial plate V-shaped, well-rounded apically, longer than broad.

Hair: Vestiture in general as in *limbus* except as follows: meso-scutal dark patch often no larger than scutellar; tergum 2 with interband zone with short suberect to subappressed hairs at least partly dark brown; terga 2 and 3 with apical areas of dark brown suberect hairs longer, on tergum 2 distal pale band often no longer medially than apical area, on tergum 3 distal white band often not reaching apex laterally; inner surfaces hind basitarsi with dark brown to black hairs.

*Male.* Measurements and ratios: N, 20; length, 8-10 mm.; width, 2.5-3.5 mm.; wing length,  $M = 2.74 \pm 0.143$  mm.; hooks in hamulus,  $M = 10.90 \pm 0.216$ ; flagellar segment 2/segment 1,  $M = 8.52 \pm 0.878$ .

Structure and color: Integumental color as in *subagilis* except as follows: labrum with large mediobasal cream-colored spot (equals half or more of total area); mandible with basal triangular yellow spot; first flagellar segment entirely brown; wing veins red to yellow. Structure as in *subagilis* except as follows: minimum length first flagellar segment equals one-eighth to one-tenth maximum length second segment and usually more than half of its own maximum length, flagellum surpassing pterostigma in repose; maxillary palpal ratio about 4.8:2.4:3.2:1.0. Sculpture as in female except as follows: galeae usually shagreened above only near tips, shiny; tergum 1 with scattered minute punctures almost to apical margin; tergum 2 with apical area impunctate; terga 3-5 similar

to 2 but apical areas progressively shorter. Terminalia as in *agilis*, sternum 8 with ventral tubercle blunt, only obscurely bidentate (Figs. 105-106).

Hair: Vestiture color as in *limbus*; however, the specimens before me are mostly much faded and worn so that the apical dark hairs of terga 2-4 are worn away but these are evident in four of the specimens from Texas and New Mexico.

*Type Material.* Holotype female of *humilior* from Organ, New Mexico, collected by T. D. A. Cockerell, September 28 at 5100 feet elevation, is in the collection of the Natural History Museum of the University of Colorado at Boulder. The holotype female of *intermediella* from Las Cruces, New Mexico, July, is also in the Natural History Museum in Boulder, Colorado.

*Distribution.* *M. humilior* is known from Texas, New Mexico, Arizona, and Chihuahua, Mexico (Fig. 33). It has been collected from June 12 to November 3. In addition to the type material, 49 females and 25 males have been examined from the localities listed below.

ARIZONA: Boyce Thompson Arbor, Superior; Chandler Heights; Chiricahua Mts. (2 miles S.); Glove (2 miles W.); Higley; Payson; Phoenix; Randolph; San Xavier Mission; Tucson. NEW MEXICO: Albuquerque; Garfield; Hot Springs; Las Cruces; Malaga (14 miles S.); Mesilla. TEXAS: Davis Mts.; Fort Davis; Santa Elena Canyon, Big Bend National Park; Tuna-Vinton highway, El Paso Co. Mexico. CHIHUAHUA: Parral (9 miles S.).

*Flower Records.* *Aster* sp., *A. crassulus*, *A. spinosus*, *A. tenacifolius*, *Grindelia* sp., *Helenium autumnale*, *Heterotheca* sp., *Isocomia* sp., *I. acradenia*, *Lygodesmia juncea*, *Solidago occidentalis*, *Sphaeralcea emoryi*, *Verbesina encelioides*.

### *Melissodes (Eumelissodes) verbesinarum* Cockerell

*Melissodes pecosella verbesinarum* Cockerell, 1905, Proc. Biol. Soc. Washington, vol. 18, p. 180; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 88; 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 17, p. 366.

This small species is very closely allied to *M. humilior*. The female of *verbesinarum* is similar to that of *humilior* but has shiny, unshagreened galeae, paler hair on the mesoscutum, and yellow to reddish brown hairs on the inner surfaces hind basitarsi. The male of *verbesinarum* can be told from that of *humilior* only with some difficulty. The *verbesinarum* males have larger yellow maculae on the mandibular bases and have denser, more branched hairs obscuring the apical margin of the first tergum as described below.



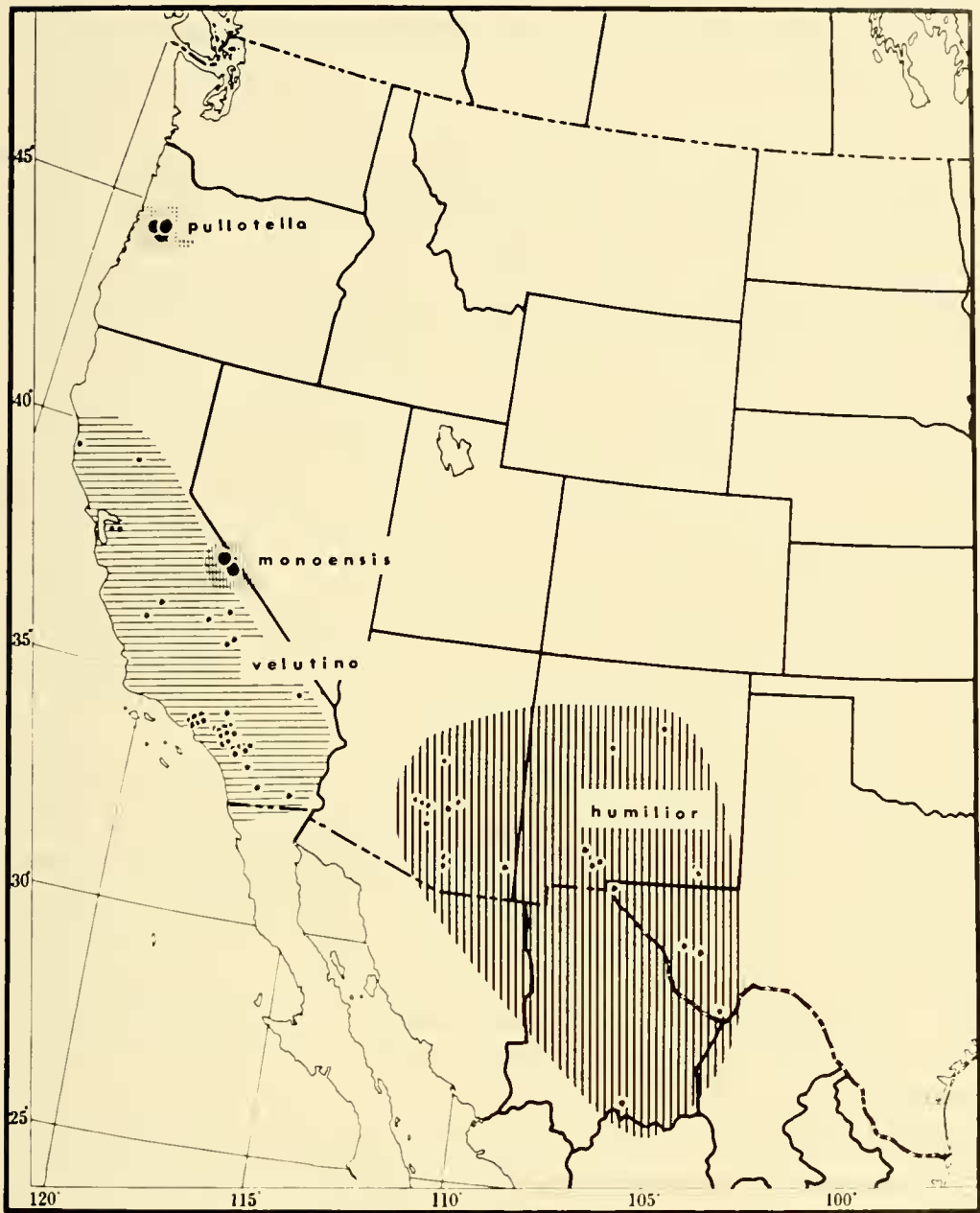


FIG. 33. Map showing the known distributions of *M. (Eumelissodes) pullatella* LaBerge, *M. (E.) monoensis* LaBerge, *M. (E.) velutina* Cockerell, and *M. (E.) humilior* Cockerell.

*Female.* Measurements and ratios: N, 20; length, 8-10 mm.; width, 2.5-3.5 mm.; wing length,  $M = 2.84 \pm 0.132$  mm.; hooks in hamulus,  $M = 12.20 \pm 0.210$ ; flagellar segment 1/segment 2,  $M = 1.87 \pm 0.100$ .

*Structure and color:* Integumental color as in *subagilis* except as follows: second flagellar segment entirely black or red below at tip only; eyes gray to grayish blue; wing veins reddish brown to brown; tegulae usually rufescent or testaceous.

Structure and sculpture as in *subagilis* except as follows: eyes larger, in profile about one and one-half as broad as gular area; clypeal punctures coarse, surface shiny, unshagreened or slightly so, apicomedial carina absent or poorly developed; supraclypeal area dulled by irregularly reticular shagreening or shiny; galeae shiny, unshagreened except at tips; maxillary palpal ratio about 2.4:2.0:2.0:1.0, first segment often slightly longer; posteromedial mesoscutal punctures separated mostly by one to three puncture widths, surface occasionally lightly shagreened; tergum 1 with basal three-fifths with crowded punctures separated mostly by half a puncture width or less; tergum 2 with basal area punctures separated mostly by one puncture width, surface unshagreened, interband zone with small, round, distinct punctures separated mostly by one puncture width or slightly more, surface moderately shiny, reticularly shagreened, apical area absent across most of tergum (except, perhaps, median third or less), if present, impunctate and less than half as long as distal pubescent band medially; tergum 3 similar to but apical area absent or virtually so and interband zone punctures denser; tergum 4 similar to 3.

Hair: Head white, with little or no brown on vertex. Thorax white laterally, dorsally with pale hairs pale ochraceous, scutellum brown fringed with white, mesoscutum with brown posteromedial patch rarely any larger than scutellar dark patch and occasionally all hairs pale ochraceous. Tergum 2 with long white basally, distal pubescent band white, reaching apical margin at least in lateral thirds, longer than interband zone, and uninterrupted medially, interband zone hairs short, subappressed, white with usually some brown mixed in medially; tergum 3 similar to 2 but brown basally and distal pubescent band reaching apex across all or most of tergum; tergum 4 like 3; terga 5 and 6 dark brown with lateral white tufts; sterna golden to reddish brown, white laterally, penultimate segment fringes apically with white. Legs white except as follows: fore tarsi pale brown; outer-apical surface middle tibiae orange-brown; basitibial plates brown; inner surfaces hind basitarsi yellow, red, or reddish-brown; scopae white.

*Male.* Measurements and ratios: N, 20; length, 9-11 mm.; width, 2.5-3.0 mm.; wing length,  $M = 2.71 \pm 0.162$  mm.; hooks in hamulus,  $M = 10.80 \pm 0.200$ ; flagellar segment 2/segment 1,  $M = 8.13 \pm 0.143$ .

Structure and color: Integumental color as in *subagilis* except as follows: labrum white with brown or testaceous apical border; mandibular base yellow (usually base wholly yellow and not with

triangular yellow area), apical half red; flagellum yellow below, red to brown above, first segment usually entirely red or brown; eyes gray to grayish blue; wing veins yellow to red; tegulae testaceous.

Structure as in *subagilis* except as follows: minimum length first flagellar segment equals about one-ninth maximum length of second, rarely as much as one-eighth; maxillary palpal ratio about 2.4:2.0:2.0:1.0, second segment often slightly longer. Sculpturing as in female except as follows: tergum 1 with minute punctures almost to apical margin; tergum 2 with basal and interband zone punctures often slightly larger and sparser; terga 3-5 as in tergum 3 of female. Terminalia as in *agilis* but sternum 8 with ventral tubercle acute, not bidentate.

Hair: Head and thorax white, occasionally slightly cinereous on dorsum of thorax; metasomal terga as in *subagilis* except as follows: all hairs and pubescence white; tergum 1 with apical area obscured by dense, appressed, short, white barbed hairs; tergum 2 with distal white band always as long medially as apical area or longer. Legs white except inner surfaces tarsi yellow.

*Bionomics.* *M. verbesinarum* is a composite oligolege, but the available floral data do not show any decided flower preferences within the family Compositae. It is certain that, in spite of its name, *verbesinarum* is not an oligolege of the genus *Verbesina*, although it has been taken on that genus a few times. Out of 61 collections (87 females and 88 males) with floral data, 49 collections (83 females and 76 males) are from some composite.

*Type Material.* Holotype female of *verbesinarum* from Las Cruces, collected by T. D. A. Cockerell, September 22, on *Verbesina enceliodes*, is in the collection of Prof. P. H. Timberlake, Citrus Experiment Station, Riverside, California.

*Distribution.* *M. verbesinarum* is known from Washington to southern California and Jalisco, Mexico, and east to Nevada and Texas (Fig. 34). It has been collected from April 25 to November 13, chiefly from June to August. In addition to the holotype, 153 females and 130 males have been examined from the localities listed below.

ARIZONA: Aguila; Atasocsa Mts.; Benson (and 5 miles W.); Bonita; Brenda (2.3 miles W.); Cameron (20 and 24 miles N.); Chiricahua Mts.; Chino Valley; Cochise; Cork; Elfrida; Eloy (7 miles W. and 8 miles S. W.); Fredonia; Gila Bend (and 25 miles E.); Globe; Higley; Holbrook (15 miles W.); Morenci; Phoenix (N. of);



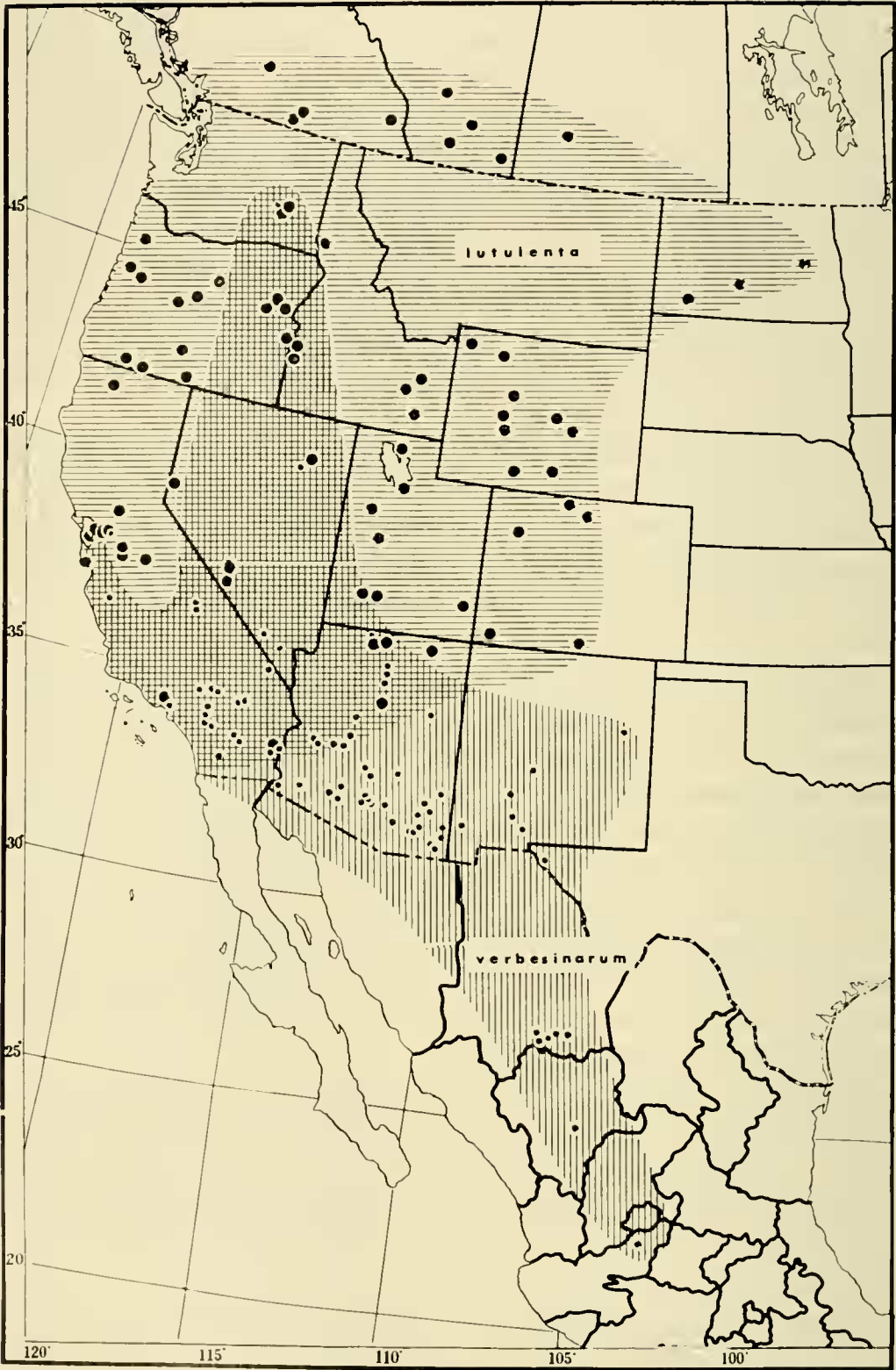


FIG. 34. Map showing the known distributions of *M. (Eumelissodes) verbesinarum* Cockerell and *M. (E.) lutulenta* LaBerge.

Picacho Pass; Prescott (32 miles S.); Red Rock; Roll; Safford; Salome (2.3 and 2.7 miles W.); San Simon; Solomon (10 miles E.); Theba; Toltec (10 miles S.); Tucson (10 miles S.); Wendel; Wenden; Wickenburg; Yuma. CALIFORNIA: Banning; Blythe; Borego Springs; Cathedral City; Chubbock (6 miles N. E.), San Bernardino Co.; Ivanpah (8 miles S.); Joshua Tree Nat. Mon. (Pinto Basin), San Bernardino Co.; Laguna Mts., Valencio Co.; Lone Pine, Inyo Co.; Lucerne Valley; Ludlow (and 6 miles W.); Morango; Newberry; Oro Grande; Palm Springs, Pasadena; Ribbonwood; Ripley (7 miles S.); Whitney Portal, Inyo Co.; Windmill Station, San Bernardino Co. NEVADA: Arden, Clark Co.; Charleston Mts., Kyle Co.; Elko. NEW MEXICO: Buckhorn; Florida (11 miles N. E.); Garfield; Hot Springs; Isleta; Las Cruces; Lordsburg; Malaga (14 miles S.); Rodeo, San Simon Valley (10 miles N.); Socorro Tucumcari. TEXAS: Cornudas, Hudspeth Co.; Davis Mts.; El Paso (20 miles N.); LaTuna-Vinton Highway, El Paso Co. WASHINGTON: Lake Paha. México. CHIHUAHUA: Agua Caliente, Santa Barbara District; Camargo (20 and 42 miles S. W.); Chihuahua; Parral (15 miles E.); Santa Barbara. DURANGO: Rodeo (12 miles N.); San Juan del Río. JALISCO: San Juan Lagos.

*Flower Records.* *Actinea* sp., *Argemone platyceros*, *Aster canescens*, *A. tenacetifolius*, *Baileya* sp., *B. multiradiata*, *Bigelovia* sp., *Cevallia sinuata*, *Chaenactis* sp., *Chrysothamnus* sp., *Croton californicus*, *Erigeron* sp., *Eysendhardtia polystachya*, *Geraea* sp., *G. canescens*, *Grindelia* sp., *Gutierrezia lucida*, *Helenium autumnale*, *Isocoma acradenia veneta*, *Lygodesmia juncea*, *Pectis papposa*, *Psilostrophe cooperi*, *Sphaeralcea* sp., *Tamarix* sp., *Verbesina encelioides*.

*Melissodes* (*Eumelissodes*) *lutulenta*, n. sp.

*M. lutulenta* is a small species extremely closely allied to *M. subagilis*. The female of *lutulenta* is difficult to separate from that of *subagilis*. The *lutulenta* female has the hairs of the anterior third of the mesoscutum erect to suberect and blunt, rather than decumbent and acute as in *subagilis*. Also, the *lutulenta* female has the pubescence of the distal pale band of tergum 2 slightly shorter than in *subagilis* as described below. The male of *lutulenta* can be readily identified by the long brown hairs medially on the scutellum and almost always posteromedially on the mesoscutum as well.

*Female.* Measurements and ratios: N, 20; length, 9-11 mm.; width, 3-4 mm.; wing length,  $M = 2.94 \pm 0.135$  mm.; hooks in

hamulus,  $M = 11.80 \pm 0.543$ ; flagellar segment 1/segment 2,  $M = 1.89 \pm 0.018$ .

Structure and color: Integumental color as in *subagilis*. Structure and sculpture as in *subagilis* except as follows: clypeal punctures round, regular, surface dulled at least posteriorly by coarse tessellation; lateral areas of vertex with punctures sparse; galeae tessellate above; maxillary palpal ratio about 4.0:3.0:2.5:1.0, minute fifth segment occasionally present; metasomal tergum 2 with basal area punctures separated mostly by half to one puncture width, surface shiny and unshagreened, interband zone punctures irregular in size and spacing, separated mostly by one to three puncture widths, surface shiny, reticulotransverse shagreening fine, apical area impunctate if present; tergum 3 similar to 2 but interband zone punctures more crowded; pygidial plate usually more pointed.

Hair: Head as in *subagilis* except vertex always with abundant brown. Thorax as in *subagilis* except as follows: hairs of anterior part of mesoscutum erect, blunt so that hair of dorsum has clipped appearance; dark mesoscutal and scutellar patches present, that of mesoscutum at least as large as and often twice area of scutellar patch; pale hairs white laterally to cinereous or pale ochraceous above. Metasomal vestiture as in *subagilis* except as follows: tergum 2 usually with short glabrous apical area in median two-fifths (allotype) or more and rarely across entire tergum, pale distal band always as apical area medially or more; tergum 3 often with short glabrous apical area but less than one-third width of tergum usually; tergum 2 with distal pale band white, composed of closely appressed, short, plumose hairs even near posterior margin of band; terga 5 and 6 with or without white lateral tufts; sterna dark brown, often white laterally and penultimate sternum usually white apically; posterior basitarsi with inner surfaces dark brown to black.

*Male.* Measurements and ratios: N, 20; length, 8-11 mm.; width 2.5-3.5 mm.; wing length,  $M = 11.55 \pm 0.138$  mm.; hooks in hamulus,  $M = 10.45 \pm 0.135$ ; flagellar segment 2/segment 1,  $M = 5.59 \pm 0.121$ .

Structure and color: Integumental color as in *subagilis* except as follows: labrum often with mediobasal cream-colored spot (not in holotype); flagellar segment 1 usually (holotype) entirely brown; veins red to dark brown or black. Structure as in *subagilis* except as follows: minimum length first flagellar segment one-fifth to one-eighth (holotype one-sixth) maximum length second segment and more than half its own maximum length; maxillary palpal ratio



about 3.5:3.0:2.5:1.0, fifth segment rarely present. Sculpture as in female except as follows: galeae above often only delicately shagreened in less than apical half, occasionally densely shagreened and occasionally shiny; clypeal punctures smaller; tergum 1 with basal four-fifths punctate; tergum 2 with interband zone punctures slightly larger and more crowded; terga 3-5 similar to 2 but apical impunctate areas progressively shorter or absent. Terminalia as in *agilis* but sternum 8 with ventral tubercle blunt, not bidentate and gonostyli scarcely capitate.

Hair: Vestiture in general as in *subagilis* except as follows: pale hairs white to cinereous, rarely pale ochraceous; scutellum with long brown hairs medially; mesoscutum usually with abundant (as in holotype) long brown hairs posteromedially; tergum 2 often with distal pale band reaching apical margin across all (holotype) or at least lateral thirds of tergum.

*Bionomics.* *M. lutulenta* is an oligolege of the Compositae and seems to prefer the genera *Chrysothamnus*, *Grindelia* and *Solidago*.

*Type Material.* Holotype male, allotype female, one male and seven female paratypes were collected by F. E. Lutz at Meeker, Colorado, July 20-21, 1919. One male and seven female paratypes from Colorado are as follows: Costilla Co.: 3 females, August 10, 1934. Mesa Verde: 1 female, August 23, 1934, F. E. Lutz; 1 female, July 22, 1937, G. F. Englehardt. Glen Haven: 1 female, August 9, 1952, R. R. Dreisbach. Medicine Bow Mts.: 1 female and 1 male, August 12, 1952, R. R. Dreisbach. The holotype and allotype are in the American Museum of Natural History, New York City. Paratypes are in the collections of the American Museum of Natural History, R. R. Dreisbach of Midland, Michigan, the Snow Entomological Museum of the University of Kansas, Lawrence, and the author's collection.

*Distribution.* *M. lutulenta* ranges from British Columbia east to Saskatchewan and south to California, Arizona and Guanajuato in Mexico (Fig. 34). It has been collected from May 25 to October 17, but chiefly in July and August. In addition to the type material, 116 females and 77 males have been examined from the localities listed below (this list includes the type localities).

ARIZONA: Black Mts. (near Kayenta); Flagstaff (7 miles S.); Houserock Canyon; Jacob Lake (6 miles N.), Coconino Co. CALIFORNIA: Antioch; Avon, Contra Costa Co.; Bear Valley, Santa Cruz Mts.; Blythe; Gazelle, Siskiyou Co.; Hopkins Well, Riverside Co.; Hospital Canyon; Juntura; Millbrae, San Mateo Co.; Modesto; Oak-

ley; Richmond; Sacramento; Turlock. COLORADO: Costillo Co.; Glen Haven; Medicine Bow Mts.; Meeker; Mesa Verde. IDAHO: Blackfoot; Downey; Homedale; Idaho Falls (Ammon Sand Hills); Lewiston; Parma. NEVADA: Deeth; Denio (50 miles S. W.), Humboldt Co.; Goldfield (and 20 miles S.); Sky Ranch, Reno. NORTH DAKOTA: Beach; Bismarck; Jamestown; Mott. OREGON: Amity (5 miles S.); Baker (10 miles S.); Bend; Corvallis; Devils Lake, Deschutte Co.; Grizzly Butte; Hereford; John Day Gorge; Klamath Falls (22 miles E.); Lakeview; Mitchell (14 miles E.); Ontario; Prineville (10 miles W.); Summer Lake; Three-Sisters. SOUTH DAKOTA: Buffalo Valley, Stanley Co. UTAH: Bear river City; Cedar Point; Dugway Proving Ground, Tooele Co.; Monticello; Panguitch; Parowan Canyon, Iron Co.; Saltair; Topaz. WASHINGTON: Lake Paha; Ritzville. WYOMING: Buffalo Bill Reservation; Carbon Co.; Lander; Owl Creek Mts.; Powder River; Rock Springs (45 miles E.); South Pass; Ten-mile Draw (E. of Casper); Yellowstone National Park. *Canada*. ALBERTA: Gleichen; Lethbridge; Medicine Hat; Scandia. BRITISH COLUMBIA: Invermeere; Kamloops; Kelowna; Nicola; Thompson River; Wasa. SASKATCHEWAN: Swift Current. *México*. GUANAJUATO: León (2 miles N. W.).

*Flower Records.* *Achillea millefolia*, *Anthemis cotula*, *Aster spinosus*, *Centromadia pungens*, *Chaemataxis* sp., *Chrysothamnus* sp., *Cleome* sp., *Grindelia* sp., *G. squarrosa*, *Gutierrezia* sp., *Helianthus* sp., *Melilotus alba*, *Solidago* sp., *S. occidentalis*.

*Melissodes (Eumelissodes) utahensis*, n. sp.

This small species is closely allied to *M. subagilis* and to *M. humilior*. The female of *utahensis* is like that of *subagilis* but has glabrous apical areas on terga 2 and 3 and is less densely punctate on the mesoscutum and terga. The female is like that of *humilior* but has the hairs of the inner surfaces of the hind basitarsi pale, the apical area of tergum 2 without or with very few dark hairs, and has less brown on the mesoscutum. The male of *utahensis* is similar to that of *limbus* but the dark apical hairs on the terga are usually absent and the galeae are usually shagreened above. It also closely resembles the male of *lutulenta* but is more finely punctate as described below.

*Female.* Measurements and ratios: N, 20; length, 9-10 mm.; width, 3.5-4.0 mm.; wing length,  $M = 2.98 \pm 0.115$  mm.; hooks in hamulus,  $M = 12.70 \pm 0.729$ ; flagellar segment 1/segment 2,  $M = 1.96 \pm 0.025$ .

Structure and color: Integumental color as in *subagilis* except eyes gray to greenish gray. Structure and sculpture as in *subagilis* except as follows: clypeus and supraclypeal area with surfaces shiny, unshagreened or shagreening sparse and fine; lateral areas vertex with punctures minute, separated mostly by three to four puncture widths; galeae above dulled by dense reticular shagreening; maxillary palpal ratio about 4.0:3.5:3.5:1.0; mesoscutal punctures peripherally separated by half to two puncture widths, posteromedially mostly by two to three puncture widths or more, surface shiny; tergum 1 with basal three-fifths with small round punctures separated mostly by one puncture width or slightly more, apical area impunctate; tergum 2 with basal area punctures separated mostly by half to one puncture width, surface unshagreened, interband zone punctures minute, mostly smaller than those of basal area and separated mostly by two to four puncture widths, apical area impunctate; tergum 3 similar to 2 but apical area usually absent or present only in median third or less.

Hair: Head white to pale ochraceous. Thorax white laterally to ochraceous above; scutellum with brown hairs medially; mesoscutum with posteromedian patch of brown hairs no larger than scutellar dark patch and often smaller. Metasomal terga as in *subagilis* except as follows: pale distal bands of terga 2-4 white or almost white; tergum 2 with distinct glabrous apical area no longer medially than distal pale pubescent band, distal pale band usually reaching apical margin at extreme sides, interband zone hairs subappressed to suberect, white to pale ochraceous; tergum 3 with glabrous apical area often reduced to median third of tergum and shorter than in tergum 2, basal and interband zone hairs dark brown; tergum 4 similar to 3 but apical area lacking; terga 5 and 6 dark brown with pale lateral tufts. Legs as in *subagilis*; inner surfaces hind basitarsi yellow to red.

*Male.* Measurements and ratios: N, 16 length, about 10 mm.; width, about 3 mm.; wing length,  $M = 2.89 \pm 0.168$  mm.; hooks in hamulus,  $M = 10.88 \pm 0.239$ ; flagellar segment 2/segment 1,  $M = 5.37 \pm 0.164$ .

Structure and color: Integumental color as in *subagilis* except as follows: labrum often with small mediobasal cream-colored spot (especially Arizona specimens, not in allotype); flagellar segment 1 usually wholly brown or red below; wing veins reddish brown to dark brown. Structure as in *subagilis* except maxillary palpal ratio about 4:3:3:1. Sculpture as in female except as follows: tergum 1



with punctures almost to apical margin; tergum 2 with basal area with surface often (allotype) reticularly shagreened, with apical area medially as long as distal pale band or shorter; terga 3-5 similar to 2 but apical areas progressively shorter to absent. Terminalia as in *agilis* and *subagilis* (Figs. 109-110).

Hair: Head white to pale ochraceous (especially vertex). Thorax white laterally to pale ochraceous above; scutellum often with abundant brown hairs medially (especially Arizona specimens, not in allotype); mesoscutum with no (allotype) to abundant brown hairs posteromedially; tergum 1 with ochraceous hairs, near apex hairs appressed and occasionally almost obscuring marginal area; tergum 2 with basal hairs white, distal pale band white to pale ochraceous and as long as or longer than apical apubescent area medially, interband zone with suberect to erect ochraceous hairs (in Arizona specimens a few of these dark brown), apical area glabrous or with long suberect pale hairs (brown in some Arizona and Nebraska specimens); terga 3-5 similar to 2 but apical areas shorter or absent and interband and basal areas often with abundant brown hairs (not in allotype except on tergum 5); terga 6 and 7 ochraceous. Legs as in *subagilis*.

*Type Material.* The holotype female and nine female paratypes from Eureka, Utah, were collected by G. E. Bohart, July 20, 1949, on *Chrysothamnus* sp. The allotype male and one male paratype from Cove Fort, Utah, were collected by G. F. Knowlton, August 4, 1949. Four female and four male paratypes from Utah are as follows: Parowan, Iron Co.: 1 female, July 27, 1919. Beaver: 1 male, August 10, 1944, C. J. Sorenson. Thistle: 1 male, August 16, 1947, G. F. Knowlton. Topaz: 1 female on *Chrysothamnus* sp., August 12, 1949, Millard. Howell: 1 male, August 21, 1949, G. F. Knowlton. Tintic: 1 male, July 1951, G. F. Knowlton. Lofgreen: 1 female, July 1951, G. F. Knowlton. Dugway Proving Ground (Granite Peak) Tooele Co.: 1 female on *Chrysothamnus* sp., July 31, 1952, Loshbaugh. The holotype and allotype are in the Snow Entomological Museum of the University of Kansas, Lawrence. Paratypes are in the collections of the Snow Entomological Museum, Utah State University, Logan, the University of Utah, Salt Lake City, and in the author's collection.

*Distribution.* *M. utahensis* is known only from Utah, Arizona, Southern California and Nebraska (Fig. 35). It has been collected from July 20 to September 28. In addition to the type ma-

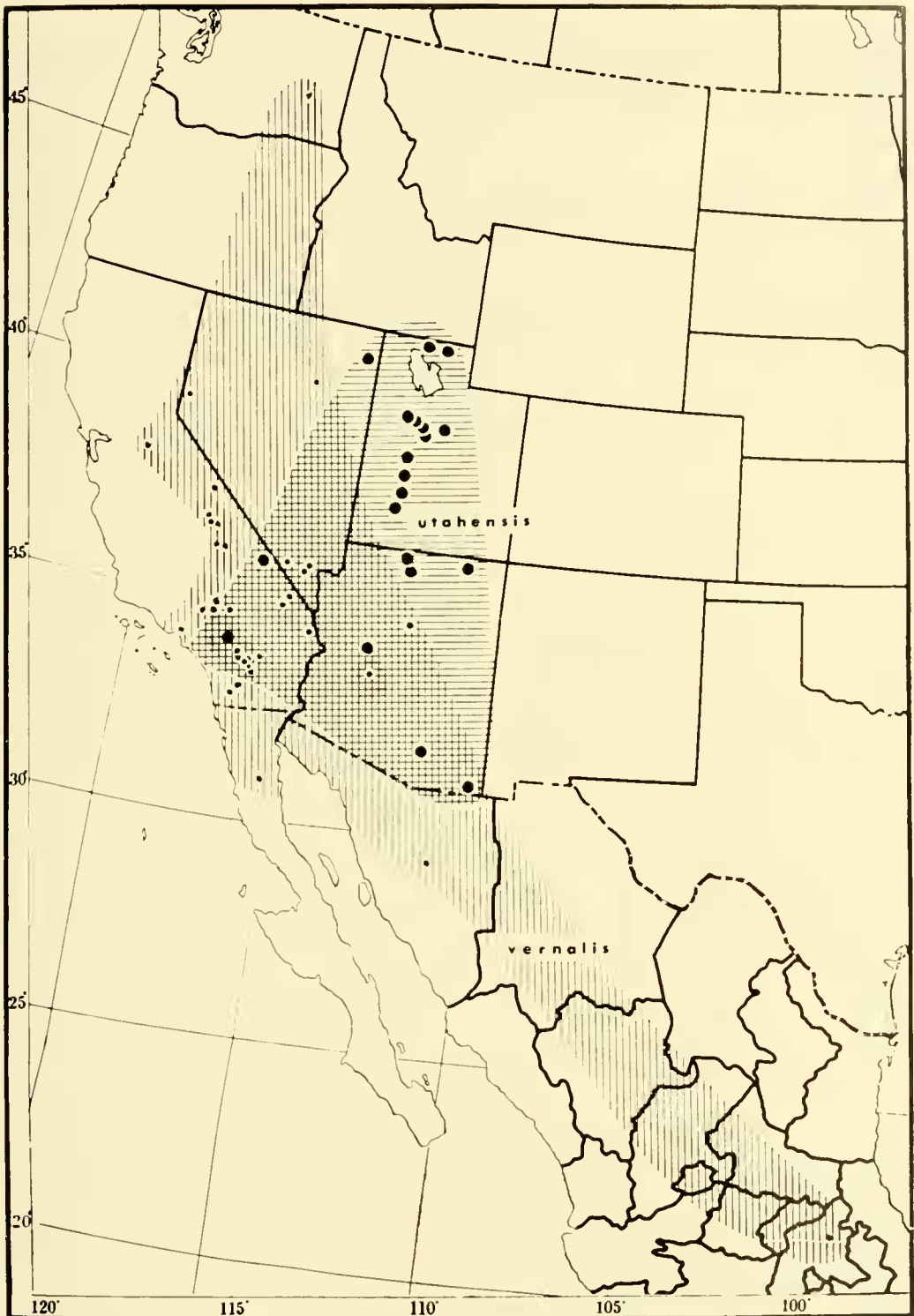


FIG. 35. Map showing the known distributions of *M. (Eumelissodes) vernalis* LaBerge and *M. (E.) utahensis* LaBerge.

terial listed above, 11 females and 5 males have been examined. The data for these is given below in full.

ARIZONA: Black Mesa (near Kayenta): 2 females on *Chaemataxis* sp., September 11, 1938, I. McCracken. Douglas: 1 male, August

20, 1933, W. W. Jones. Grand Canyon: 6 females and 1 male, August 19, 1939, E. C. Van Dyke; 2 males, July 26, 1954, H. E. and M. A. Evans. Jacob Lake, Coconino Co.: 1 male, July 24, 1952, Cazier, Gertsch and Schrammel. Kirkland (Peeples Valley), Yavapai Co.: 1 female, August 22-24, 1927. Sabino Basin, Santa Catalina Mts.: 2 females, September 28, C. H. T. Townsend. CALIFORNIA: Santa Ana River, San Bernardino Co.: 1 female on *Gutierrezia californica*, 1 male on *Chrysothamnus nauseosum*, August 23, 1952, P. H. Timberlake; Westgard Pass, Inyo Co.: 1 male, July 10, 1953, E. G. Linsley. NEBRASKA: Monroe Canyon, Sioux Co.; 1 male, August 18, 1912, E. J. Taylor. NEVADA: Oasis (20 miles W.): 1 female, August 12, 1951, A. T. McClay. UTAH: Cache Junction.

*Melissodes (Eumelissodes) brevipyga*, n. sp.

This small desert bee is closely related to *M. verbesinarum* and the females of the two species are very similar. The *brevipyga* female has smaller eyes (not twice or more as broad as the gular area in profile as in *verbesinarum*), the apical area of tergum 2 (and usually of tergum 3) glabrous, and vein 2nd m-cu interstitial with vein 2nd r-m in the fore wing. The female of *brevipyga* also resembles that of *humilior* and that of *utahensis* but can be separated from these by the shiny galeae, as well as the venation character given above. The male of *brevipyga* has a distinctive short broad pygidial plate, shiny galeae, black mandibular bases, and a conspicuous white mediobasal labral macula.

*Female.* Measurements and ratios: N, 20, length 8-11 mm.; width, 3-4 mm.; wing length,  $M = 2.93 \pm 0.058$  mm.; hooks in hamulus,  $M = 11.95 \pm 0.135$ ; flagellar segment 1/segment 2,  $M = 1.83 \pm 0.018$ .

Structure and color: Integumental color as in *subagilis*. Structure and sculpture as in *subagilis* except as follows: clypeal punctures crowded, surface shiny, unshagreened, apicomedian carina usually reduced to a small subapical boss; lateral areas of vertex with small shallow punctures separated by one to three puncture widths, often dulled by fine tessellation (as in allotype); galeae shiny, unshagreened above except in apical one half or less; maxillary palpal ratio about 14:8:6:1, fourth segment often completely lacking, second and third usually seem to be fused; mesoscutal punctures large, deep, posteromedian area impunctate or with scattered large punctures; fore wings with vein 2nd m-cu interstitial with vein 2nd r-m; tergum 1 with basal area punctures separated mostly by half a



puncture width or less, surface shiny, interband zone punctures distinct, separated by half to one puncture width, apical area impunctate, shiny; tergum 3 similar to 2 but interband zone punctures more crowded; pygidial plate no longer than broad at base, apex well rounded.

Hair: Head white. Thorax white, scutellum occasionally with several brown medially, mesoscutum occasionally with sparse brown posteromedially. Tergum 1 with long white basally, with short white appressed pubescence near apical margin in lateral fifths or less; tergum 2 white basally, distal pale band white, about as long medially as apical area, uninterrupted, interband zone hairs short, appressed to suberect, white, apical area bare; tergum 3 similar to 2 but basal tomentum and interband zone hairs dark brown and apical area shorter; tergum 4 similar to 3 but distal pale band apical; terga 5 and 6 dark brown medially to white laterally. Legs white except as follows: fore tarsi pale brown; outer-apical surfaces middle tibiae pale brown; basitibial plates brown; inner surfaces hind basitarsi dark brown to reddish brown (allotype).

*Male.* Measurements and ratios: N, 20; length, 9-10 mm.; width, 2-3 mm.; wing length,  $M = 2.69 \pm 0.123$  mm.; hooks in hamulus,  $M = 11.15 \pm 0.131$ ; flagellar segment 2 segment 1,  $M = 6.07 \pm 0.064$ .

Structure and color: Integumental color as in *subagilis* except as follows: clypeus pale yellow; labrum with large mediobasal white spot equaling more than one-third area of labrum; mandibles without basal yellow spots. Structure as in *subagilis* except as follows: minimum length first flagellar segment one-sixth to one-eighth maximum length second segment; maxillary palpal ratio about 4.0:2.7:2.0:1.0, fourth segment much shorter or virtually absent in some specimens; pygidial plate short and broad, usually broader at base than median length. Sculpture as in female except as follows: mesoscutal punctures more crowded, especially posteromedially; tergum 1 with basal four-fifths punctate; tergum 2 with interband zone punctures often separated by one to two puncture widths; terga 3-5 similar to 2 but interband zone punctures more crowded and apical areas progressively shorter to absent. Terminalia as in *agilis* and *subagilis* (Figs. 111-112).

Hair: Head white. Thorax white, on mesoscutum especially, and usually on scutellum, long white hairs decumbent. Metasomal vestiture as in *subagilis* except generally white. Legs as in *subagilis* but white.

*Bionomics.* *M. brevipyga* seems to be restricted to the desert regions of the southwest. It is an oligolege of the Compositae and seems to prefer the genera *Isocoma* and *Aster* in that order, and has been collected mostly from these two genera.

*Type Material.* The holotype male, allotype female, and two male and fourteen female paratypes were collected seven miles south of Ripley, Riverside Co., California, October 19, 1951, on *Aster* sp., by P. D. Hurd. In addition, 55 female and 7 male paratypes were collected seven miles south of Ripley, California, October 19, 1951, by P. H. Timberlake as follows: 2 females on *Baccharis* sp., 48 females and 4 males on *Aster tephrodes*, 1 female on *Aster spinosus*, and 4 females and 3 males on *Palofoxia linearis*. The holotype and allotype are in the collection of the University of California at Berkeley. Paratypes are in the collections of the University of California, Prof. P. H. Timberlake, Citrus Experiment Station, Riverside, California, the Snow Entomological Museum of the University of Kansas, Lawrence, and in the author's collection.

*Distribution.* *M. brevipyga* is known from California, Arizona and Idaho (Fig. 32). It has been collected from June 26 to November 15, but chiefly in October. In addition to the type material, 136 females and 13 males have been examined from localities listed below (the list includes the type locality).

ARIZONA: Two-gun, Coconino Co.; Yuma. CALIFORNIA: Coachella, Riverside Co.; Deep Springs, Inyo Co.; Helendale, Mojave Desert; Hopkins Well, Riverside Co.; Indio (and 2.8 miles S. E. and 6 miles N. W.); Newberry, San Bernardino Co.; Piñon Flat; Ripley (7 miles S.); San Diego; Westgard Pass (3 miles N.), Inyo Co. IDAHO: Declo.

*Flower Records.* *Aster* sp., *A. spinulosus*, *A. tephrodes*, *Baccharis* sp., *Chrysothamnus* sp., *Gutierrezia californica*, *G. sarothrae*, *Isocoma* sp., *I. acradenia*, *Palofoxia linearis*.

*Melissodes (Eumelissodes) vernalis*, n. sp.

This small species is closely related to *M. limbus*. The female of *vernalis* is similar to that of *limbus* but has shiny galeae, less punctate mesoscutum, and the tergal apices translucent, usually smoky to almost colorless. The male is like that of *limbus* except the galeae are shiny above and the pygidial plate is narrower than usual for a *Eumelissodes* species.

*Female.* Measurements and ratios: N, 20; length, 9-12 mm.;

width, 3.5-4.0 mm.; wing length,  $M = 3.00 \pm 0.123$  mm.; hooks in hamulus,  $M = 12.30 \pm 0.179$ ; flagellar segment 1/segment 2,  $M = 1.82 \pm 0.066$ .

Structure and color: Integumental color as in *subagilis* except as follows: eyes gray to bright green (holotype); wing veins dark brown to black; tegulae not usually rufescent, piceous, tergum 1 with broad hyaline, red to colorless margin (red in holotype); terga 2-4 with apical areas translucent and smoky to hyaline and colorless.

Structure and sculpture as in *subagilis* except as follows: clypeal surface unshagreened; supraclypeal area usually with abundant punctures, surface shiny; lateral areas vertex with minute punctures separated by two to four puncture widths, surface shiny; galeae shiny above, unshagreened except near tips; maxillary palpal ratio about 4.0:3.0:2.5:1.0; mesoscutum with posteromedian area impunctate or with scattered punctures, mesoscutal punctures smaller than in *brevipyga*; metasomal tergum 1 with basal half with small shallow punctures separated mostly by one puncture width, surface and bottoms of punctures dulled by shagreening, apical area with distinct anterolateral impunctate lobes; tergum 2 with basal area punctures separated mostly by one puncture width, surface shiny, interband zone punctures minute, smaller than those of basal area, separated mostly by two to four puncture widths, apical area impunctate; tergum 3 similar to 2 but apical area lacking or restricted to one-third or less of width of tergum (less in holotype) and shorter; tergum 4 similar to 3 but lacking apical area; pygidial plate as in *subagilis*.

Hair: Head white except long brown on vertex. Thorax white laterally, pale ochraceous to white dorsally except abundant brown on scutellum and mesoscutum, mesoscutal dark patch as large as to twice size of scutellar (in holotype twice size); tegulae often with brown (present in holotype). Tergum 1 with long white hairs basally, glabrous apically, anterolateral lobes of apical area often with minute, simple, closely appressed, brown hairs (holotype); tergum 2 white basally, distal pale band white, interband zone about as long medially as distal pale band and with short, appressed to suberect, dark brown hairs, apical area with abundant suberect dark brown hairs; tergum 3 similar to 2 but basal tomentum brown and apical area shorter, not as wide and occasionally absent; tergum 4 similar to 3 but apical area absent; terga 5 and 6 pale brown medially (often darker basally) with white lateral



tufts; sterna yellow to reddish brown medially, white laterally and apically. Legs as in *limbus*.

*Male*. Measurements and ratios: N, 20; length, 9-11 mm.; width, 2.5-3.5 mm.; wing length,  $M = 2.90 \pm 0.114$  mm.; hooks in hamulus,  $M = 11.60 \pm 0.775$ ; flagellar segment 2/segment 1,  $M = 6.03 \pm 0.127$ .

Structure and color: Integumental color as in *subagilis* except as follows: labrum with large mediobasal white or cream-colored spot equal to more than one-third and often more than one-half area of labrum; wing veins dark reddish brown to black.

Structure as in *subagilis* except as follows: minimum length first flagellar segment equals one-sixth to one-eighth maximum length second segment; maxillary palpal ratio about 3.5:3.0:2.5:1.0; pygidial plate long and narrow, usually about twice as long as median width, with weakly defined apicolateral notches. Sculpture as in female except as follows: clypeal punctures weak; tergum 1 punctate to within one-sixth or one-fifth of apical margin; terga 2 and 3 with interband zones with small round distinct punctures separated mostly by two to three puncture widths; terga 4 and 5 similar to 2 but apical areas shorter or absent. Terminalia as in *agilis* but sternum 8 with ventral tubercle acute, not bidentate (Figs. 113-114).

Hair: Head white. Thorax white except scutellum brown medially and mesoscutum usually with posteromedian brown patch as large as or slightly larger than scutellar dark patch. Metasomal vestiture as in *subagilis* except as follows: generally white rather than ochraceous; tergum 2 with distal pale band usually as long as or slightly shorter than apical apubescent area medially. Legs as in *subagilis* but white.

*Bionomics*. *M. vernalis* is another composite oligolege and seems to prefer the genera *Encelia* and *Geraea* to all others. However, the available floral data are very scant.

*Type Material*. The holotype female with one female paratype from Mazourka Canyon, Inyo Mts., Inyo Co., California, was collected by C. D. Michener, June 1, 1937, on *Encelia farinosa*. The allotype male from the same locality and flower was collected by C. D. Michener on June 11, 1937. In addition, 15 females and 14 male paratypes from Inyo Co., California, are as follows: Mazourka Canyon: 1 female, May 25, 1937, N. W. Frazier. Inyo Mts.: 1 male, May 23, 1937; 1 male, June 1, 1937, E. C. Van Dyke; 1 male,

June 5, 1939, on *Sphaeralcea ambigua*, R. M. Bohart. Lone Pine: 1 male, May 19, 1937, 2 males, June 9, 1937, E. C. Van Dyke. Panamint Mts.: 1 male, May 24, 1937, W. C. Reeves; 11 females and 3 males, May 30, 1937, E. C. Van Dyke. Argus Mts. (near Darwin Falls): 1 female, May 30, 1937, C. D. Michener. Keeler (4 miles S. E.): 1 male, May 22, 1937, on *S. ambigua*, E. C. Van Dyke; 1 male, May 22, 1937, on *S. ambigua*, C. D. Michener; Westgard Pass: 2 females (7 miles W.), June 26, 1953, J. W. MacSwain; 2 males, June 13, 1937, G. E. Bohart. The holotypes and allotype are in the Snow Entomological Museum of the University of Kansas, Lawrence. Paratypes are in the collections of the Snow Entomological Museum, the California Academy of Sciences, San Francisco, the American Museum of Natural History, New York City, the University of California, Berkeley, the Utah State University, Logan, and in the author's collection.

*Distribution.* *M. vernalis* ranges from Washington south to Baja California and Hidalgo in Mexico, and east to Nevada (Fig. 35). It has been collected from March 28 to October 12, but mainly in April, May and June. In addition to the type material, 60 females and 60 males have been examined from the localities listed below (list includes type localities).

ARIZONA: Oak Creek Canyon; Wellton; Wickenburg (20 miles N. W.). CALIFORNIA: Andreas Canyon; Argus Mts. (near Darwin Falls); Beal Well; Bonanza Mine, Providence Mts.; Borego; Box Canyon, Riverside Co.; Cathedral City; Edom, Riverside Co.; Fish Springs; Indio; Inyo Mts.; Kane Spring (7, 8 miles N. W.); Keeler (4 miles S. E.); Kramer; Lone Pine; Los Angeles; Los Angeles Co.; Lovejoy Buttes; Mazourka Canyon, Inyo Mts.; Mecca (3 miles S.), Riverside Co.; Micheli Caverns, San Bernardino Co.; Mojave Desert; New York Mts.; Oasis, Mono Co.; Palm Canyon; Palm Springs, Panamint Mts.; San Diego Co.; Snow Creek, San Jacinto Mts.; Thousand Palms; Valley Spring (3 miles E.); Westgard Pass (7 miles W.); Yermo, San Bernardino Co. NEVADA: Arden (3 miles E.); Charleston Mts., Clark Co.; Las Vegas; Lee Canyon; Reno (29 miles E.). WASHINGTON: Ritzville. MÉXICO. BAJA CALIFORNIA: San Augustine. HIDALGO: Pachuca. SONORA: San Bernardo.

*Flower Records.* *Aster abatus*, *A. agnatus*, *Baileya* sp., *B. multiradiata*, *Bebbia juncea*, *Chilopsis linearis*, *Encelia* sp., *E. farinosa*, *Geraea* sp., *G. canescens*, *Hyptis emoryi*, *Melilotus* sp., *Prosopis* sp., *Psilostrophe cooperi*, *Sphaeralcea ambigua*, *Viguiera deltoides*.

*Melissodes (Eumelissodes) velutina* (Cockerell)

*Exomalposis velutinus* Cockerell, 1916, Pomona Jour. Ent. Zool., vol 8, p. 58; Bray, 1917, Pomona Jour. Ent. Zool., vol. 9, p. 95.  
*Melissodes velutina*, Michener, 1951, in Muesebeck *et al*, Hymenoptera of America North of Mexico, Synoptic Catalog, U. S. Dept. Agric., Agric. Monogr. No. 2, p. 1229.

*Melissodes velutina* is a distinctive pale bee from the deserts of southern California. It is closely related to *M. vernalis*. The female is distinctive in having translucent, smoky or rufescent, tergal apices, pale hairs on terga 5 and 6, and somewhat infumate wing membranes. The male is like that of *verbesinarum* in having both a large mediobasal pale labral spot and large yellow basal mandibular spots, but differs in that the wings are somewhat infumate, the wing veins are dark brown to black, and the pygidial plate quite narrow.

*Female*. Measurements and ratios: N, 20; length, 9-12 mm.; width, 3-4 mm.; wing length,  $M = 2.80 \pm 0.149$  mm.; hooks in hamulus,  $M = 12.85 \pm 0.997$ ; flagellar segment 1/segment 2,  $M = 1.87 \pm 0.022$ .

Structure and color: Integumental color as in *subagilis* except as follows: tergum 1 with apical third rufescent to yellow; terga 2-4 with apical areas translucent, yellow to smoky red (usually deeper color basad); eyes gray to bluish gray; wing membranes somewhat infumate, yellowish brown, veins dark brown to black; tegulae piceous.

Structure and sculpture as in *subagilis* except as follows: clypeal punctures coarse, separated mostly by less than half a puncture width, surface shiny, bottoms of punctures tessellate (at least larger punctures), mediobasal carina weakly developed; supra-clypeal area punctate, unshagreened; galeae above unshagreened; lateral areas vertex with punctures separated mostly by one to two puncture widths, surface shiny; maxillary palpal ratio about 2.7:2.7:2.5:1.0; posteromedial mesoscutal area with scattered punctures separated mostly by one to three puncture widths; metasomal tergum 1 with basal three-fifths punctate; tergum 2 with basal area punctures minute, separated mostly by two or more puncture widths, interband zone punctures slightly larger, separated mostly by two to three puncture widths, apical area impunctate; tergum 3 similar to 2 but apical area absent or reduced to apicomedian triangle; pygidial plate V-shaped, rounded apically, longer than broad.

Hair: Head white to ochraceous with scattered brown hairs on vertex. Thorax white or pale ochraceous laterally, ochraceous to



yellow above except scutellum dark brown with pale fringe, meso-scutum with posteromedian dark brown patch about twice size of scutellar dark area, and tegulae dark brown. Metasomal tergum 1 pale ochraceous basally, anterolateral lobes of apical area with short, subappressed, dark brown hairs, with white to pale ochraceous, appressed pubescence apical to anterolateral lobes; tergum 2 white basally, distal pale band white to pale ochraceous, reaching apical margin at extreme sides, narrowly connected to basal white band at extreme sides, longer than apical area medially; interband zone with short, subappressed, dark brown hairs, apical area with short, suberect, ochraceous to brown hairs; tergum 3 similar to 2 but distal pale band reaching apical margin across all or most of tergum, apical area, if present, reduced to small triangular or diamond-shaped area usually less than one-third width of tergum, interband zone with scattered short white pubescence; tergum 4 like 3 but apical area absent; terga 5 and 6 ochraceous to orange medially to white laterally (darker basally); sterna orange to brown with white apical fringes. Legs white except as follows: fore tarsi pale brown; outer-apical surfaces fore and middle tarsi orange to pale brown; basitibial plates orange-brown; inner surfaces hind basitarsi yellow to orange-red.

*Male.* Measurements and ratios: N, 20; length, 9-11 mm.; width, 2.5-3.5 mm.; wing length,  $M = 2.73 \pm 0.133$  mm.; hooks in hamulus,  $M = 11.00 \pm 0.670$ ; flagellar segment 2/segment 1,  $M = 6.83 \pm 0.183$ .

Structure and color: Integumental color as in *subagilis* except as follows: labrum cream-colored to white with brown apical margin; mandibles with large basal yellow spots; eyes gray to bluish gray; wing membranes slightly infumate, veins dark brown; tegulae piceous; tergal apices translucent, colorless to yellowish brown.

Structure as in *subagilis* except as follows: minimum length first segment about one-sixth maximum length second segment, minimum width penultimate segment slightly less than one-third length, flagellum reaches slightly beyond pterostigma in repose; maxillary palpal ratio about 3.5:2.5:2.5:1.0; pygidial plate narrow, almost twice as long as median width, subapical notches indistinct. Sculpture as in female except as follows: mesoscutum often impunctate posteromedially; tergum 1 with basal four-fifths punctate; terga 3-5 similar to 2 but apical areas progressively shorter; terga 2-4 with interband zone punctures larger and more abundant. Terminalia much as in *agilis*; gonostyli narrow and long; sternum 7

with median plate extending apically and outward viewed from posterior edge it is boot-shaped or shoe-shaped; sternum 8 with ventral tubercle large, blunt, not bidentate.

Hair: Head and thorax white to pale ochraceous but scutellum with dark brown medially and mesoscutum with dark brown posteromedian patch usually present and rarely larger than scutellar dark areas and never twice as large. Metasomal vestiture as in *subagilis* except as follows: tergum 1 with subappressed apical hairs often dark brown or brown, usually white; tergum 2 with interband zone and apical area hairs usually white, often brown to dark brown; terga 3 and 4 often with brown suberect hairs apically, interband zones often with some erect brown bristlelike hairs. Legs as in *subagilis*.

*Bionomics.* *M. velutina* seems to be an oligolege of the genus *Hugelia* (Polemoniaceae). Out of a total of 79 collections (117 females and 9 males) bearing floral data, 42 collections (82 females and 2 males) were made from some species of *Hugelia* (mostly *H. virgata*). It has also been collected on a number of composites among which *Gutierrezia* was the most often visited (10 collections of 11 females). Among the other families of plants from which *velutina* has been collected only the Boraginaceae appears important. (*Cryptantha intermedia* with five collections of five females and one male.)

*Type Material.* The holotype female of *velutina* from Claremont, California, collected by Baker, is in the collection of the American Museum of Natural History, New York City.

*Distribution.* *M. velutina* is known only from southern California north to Antioch (Fig. 33). It has been collected from April 3 to August 11 but chiefly in May and June. In addition to the holotype, 152 females and 37 males have been examined from the localities listed below.

CALIFORNIA: Aguanga; Alpine; Altadena; Andreas Canyon, Inyo Co.; Antioch; Banning; Bonanza Mine, Providence Mts.; Cabazon, Riverside Co.; Cajon Pass, San Bernardino Co.; Cajon Valley; Claremont; Coalinga (4 miles W.); Colton; Contra Costa Co.; Corona; Crestline, San Bernardino Co.; Devore (and 3 miles S. W.); Eagle Rock Hills, Los Angeles Co.; Gavilan; Gillman Hot Springs, Riverside Co.; Imperial Co.; Kern Camp (8 miles W.), San Jacinto Mts.; Los Angeles Co.; Lovejoy Buttes; Ontario; Palm Springs; Panamint Mts., Inyo Co.; Pasadena; Perris (1.5 miles W.); Phelan; Pocatello Island; Riverside; San Bernardino; San Felipe Creek; San Gabriel

Mts. (near Pasadena); Sequoia National Park (Ash Mt.); Tanbark Flat, Los Angeles Co.; Watts Valley, Fresno Co.; Yankee Hill, Butte Co.

*Flower Records.* *Acanthopappus sphaerocephalus*, *Aster abatus*, *Chorizantha statioloides*, *Cirsium* sp., *Coreopsis* sp., *C. lanceolatum*, *Cryptantha intermedia*, *Eremocarpus setiger*, *Eriogonum fasciculatum*, *Gutierrezia californica*, *G. sarothrae*, *Helianthus gracilentus*, *Heliotropium oculatum*, *Hugelia ambigua*, *H. virgata*, *Lotus scoparius*, *Marrubium vulgare*, *Mirabilis laevis*, *Monarda lanceolata*, *Prosopis* sp., *Salvia columbaris*, *Trichostema lanatum*.

*Melissodes (Eumelissodes) saponellus* Cockerell

*Melissodes saponellus* Cockerell, 1908, Canadian Ent., vol. 40, p. 234.

This small species is known only in the female sex. It is clearly related to *M. velutina* and resembles the latter in the translucent tergal apices which are in *saponellus* colorless or very nearly so. The female of *saponellus* differs from that of *velutina* by the small impunctate posteromedian area of the mesoscutum, the colorless to slightly milky wing membranes and paler veins, the lack of brown hairs on mesoscutum, scutellum and tegulae, and the slightly different punctuation of the second tergum as described below.

*Female.* Measurements and ratios: N, 17; length, 10-11 mm.; width, 3.5-4.0 mm.; wing length,  $M = 2.97 \pm 0.088$  mm.; hooks in hamulus,  $M = 11.71 \pm 0.187$ ; flagellar segment 1/segment 2,  $M = 1.85 \pm 0.023$ .

Structure and color: Integumental color as in *velutina* except as follows: apical areas terga 2-4 colorless to extremely slightly yellowish, tergum 1 broadly hyaline and colorless apically, hyaline area becoming yellow to red basad; eyes gray to yellowish or greenish gray; wing membranes not infumate, colorless or slightly milky, veins dark red to reddish brown; tegulae usually rufescent. Structure and sculpture as in *velutina* except as follows: clypeal punctures slightly smaller especially apically; maxillary palpal ratio about 8:5:4:1; mesoscutum with posteromedian area impunctate or with scattered punctures separated by less than half to five or more puncture widths; tergum 1 with basal three-fifths with punctures separated mostly by half to one puncture width; tergum 2 with basal area punctures larger, separated mostly by half a puncture width, surface dulled by fine reticular shagreening, interband zone punctures of similar size, irregular, spaced by half to three puncture widths; pygidial plate broadly rounded, almost U-shaped.



Hair: Head and thorax white, without brown on vertex, tegulae, mesoscutum, or scutellum. Metasomal vestiture as in *velutina* except as follows: entirely white except terga 4 and 5 ochraceous mediobasally; tergum 2 with distal pale band reaching apex laterally and twice as long as apical area medially; tergum 3 with apical area absent or reduced to extremely short area about one-fourth width of tergum; sterna yellow except white apical fringe on each and white laterally. Legs white except as follows: fore tarsi ochraceous; outer-apical surface middle and often fore tibiae pale orange; basitibial plates orange; inner surfaces hind basitarsi yellow to orange-red.

*Type Material.* The holotype female from Grand Coulee (Soap Lake), Washington, collected on June 29, 1902, is in the collection of Prof. P. H. Timberlake of the Citrus Experiment Station, Riverside, California.

*Distribution.* *M. saponellus* is known from the states of Washington, Oregon, Utah, and Colorado (Fig. 29). In addition to the holotype, 17 females have been examined. Data for these is given in full below.

COLORADO: Delta (5 miles N.): 1 female, June 30, 1938, U. Lanham. OREGON: Powell Butte, Crook Co.: 1 female on Alsike clover, July 11, 1941, H. A. Scullen. UTAH: Bluff: 1 female, July 7, 1935, C. Brues. Jensen (12 miles E.): 3 females on *Sphaeralcea* sp., P. H. Timberlake. Oak City: 1 female, June 24, 1949, G. E. Bohart. Vernal (5 miles N.): 7 females on *Chaenactis stenoides* and 1 female on *Bahia oblongifolia*, June 24, 1950, C. D. Michener. Zion Canyon: 2 females, May 6, 1948, G. E. Bohart. WASHINGTON: Grand Coulee (Soap Lake): holotype female.

*Melissodes (Eumelissodes) appressa*, n. sp.

*M. appressa* is a small species known only from California and related to *M. subagilis*. The female is distinctive in the form of the distal pubescent band of tergum 2 and of the pubescence composing that band as described below. The female also has the hairs of the mesoscutum short, blunt-tipped, and decumbent, as in certain members of the *microsticta* group, shiny galeae, and dark reddish brown hairs on the inner surfaces of the hind basitarsi. The male of *appressa* is like that of *subagilis* in the antennal lengths and color of the labrum and mandible, but is more like the male of *verbesinarum* in the tergal vestiture and in the shiny galeae.

*Female.* Measurements and ratios: N, 20; length, 10-12 mm.; width, 3-4 mm.; wing length,  $M = 2.67 \pm 0.153$  mm.; hooks in hamulus,  $M = 12.45 \pm 0.153$ ; flagellar segment 1/segment 2,  $M = 1.98 \pm 0.017$ .

Structure and color: Integumental color as in *subagilis* except as follows: tergal apices only slightly rufescent; wing veins dark reddish brown; tegulae piceous.

Structure and sculpture as in *subagilis* except as follows: clypeal punctures large, separated mostly by half puncture width or less, surface shiny, apicomedian carina weak; galeae above shiny, unshagreened except in apical third or less; maxillary palpal ratio about 2.7:2.0:1.7:1.0; third flagellar segment with length subequal to maximum width; mesoscutum with posteromedian area punctures large, separated mostly by one to two puncture widths except in small posteromedial impunctate area usually present, peripherally punctures separated mostly by half to one puncture width, surface shiny; metasomal tergum 1 with basal three-fifths with punctures separated mostly by half to one puncture width or slightly more, apical area impunctate, shiny, without impunctate anterolateral lobes; tergum 2 with basal area punctures separated mostly by one puncture width, surface shiny but may have fine reticular shagreening, interband zone punctures slightly larger than basal area punctures, regularly spaced, separated mostly by one puncture width or slightly more, apical area, if present, impunctate, but small punctures present beneath pubescence of distal pale band; terga 3 and 4 like 2 but interband zone punctures denser and apical areas usually lacking; pygidial plate V-shaped, apex rounded.

Hair: Head white to pale ochraceous with abundant brown on vertex. Thorax white to pale ochraceous laterally; mesoscutum pale ochraceous to yellowish with large posteromedian dark brown patch usually about twice size of scutellar dark area, occasionally larger; mesoscutal hairs blunt-tipped giving clipped appearance, decumbent in anterior third. Metasomal tergum 1 white to pale ochraceous basally and to apical margin at sides, apicomediaally glabrous; tergum 2 with basal white tomentum connected at extreme sides with distal white to pale ochraceous band, distal pale band reaches apical margin at least in lateral fifths and often across most of tergum, composed of short, broad, scalelike, appressed pubescence which in apical half of band (especially medially) do not or barely overlap one another, each hair twice as long as broad or shorter, occasionally along apical margin of band and especially medially

some pubescence brown, apical area when present bare or with one or two irregular rows of short, brown, appressed to subappressed, simple hairs; tergum 3 like 2 but basal tomentum brown, apical area usually absent or extremely short and no broader than one-third width of tergum, and short, pale, appressed pubescence of distal band also covers interband zone, but hairs longer; tergum 4 like 3 but apical area absent; terga 5 and 6 dark brown with white lateral tufts; sterna yellow medially, white apically and laterally on each but the last. Legs as in *subagilis* but scopal hairs white and inner surfaces hind basitarsi dark reddish brown to red.

*Male.* Measurements and ratios: N, 20; length, 8-11 mm.; width, 2.5-3.0 mm.; wing length,  $M = 2.56 \pm 0.144$  mm.; hooks in hamulus,  $M = 11.40 \pm 0.152$ ; flagellar segment 2/segment 1,  $M = 5.86 \pm 0.145$ .

Structure and color: Integumental color as in *subagilis* except as follows: wing veins red to reddish brown; tergal apices colorless.

Structure as in *subagilis* except as follows: minimum length first flagellar segment usually one-seventh to one-eighth maximum length second segment, flagellum in repose reaching or slightly surpassing pterostigma, penultimate segment more than three times as long as broad; maxillary palpal ratio about 3.0:2.5:2.0:1.0; sternum 6 with subapical oblique carinae weakly developed. Sculpture as in female except as follows: mesoscutum often without impunctate posteromedian area; metasomal tergum 1 punctate almost to apical margin; terga 2 to 4 with interband zones with punctures sparser, separated by one to two puncture widths, apical areas usually lacking.

Hair: Head and thorax white, occasionally pale ochraceous on mesoscutum; mesoscutal hairs not blunt-tipped, often decumbent in apical third. Metasomal tergum 1 with white to pale ochraceous hairs, in apical fifth to fourth hairs appressed and forming apical band obscuring apical margin of tergum; tergum 2 with white basal tomentum, white distal pubescent band which reaches apical margin in lateral fourths or more, occasionally reaching apex across entire tergum, apical area when present less than half length of distal pale band medially, half or less width of tergum, and glabrous, interband zone with long, suberect to erect, pale hairs; terga 3-5 similar to 2 but distal pale band apical (or tergum 3 occasionally with small glabrous apical area); terga 6 and 7 ochraceous to white; sterna yellow medially to white laterally. Legs white except inner surfaces tarsi yellow. Terminalia as in *agilis* and *subagilis*.



*Bionomics.* *M. appressa* is an oligolege of the Compositae. It seems to prefer the genera *Isocoma*, *Gutierrezia*, and *Heterotheca* in that order. The available floral data are summarized in Table XVII. Most of these data are due to the assiduous collecting of Prof. P. H. Timberlake in the Riverside area of southern California.

*Type Material.* The holotype female collected at Riverside, California, September 25, 1927, on *Isocoma vernonioides* by P. H. Timberlake. The allotype male and seventeen female paratypes were collected by Timberlake at Riverside on *I. vernonioides* on September 18, 1927. In addition to these, 14 female and 9 male paratypes were collected by P. H. Timberlake at Riverside, California, during 1927, as follows: 2 females, 1 male, on *I. vernonioides*, September 11; 1 male on *Gutierrezia sarothrae*, September 12; 1 female on *G. sarothrae*, September 19; 1 female on *I. vernonioides*, September 20; 1 female on *Heterotheca grandiflora*, September 27; 2 females and 1 male on *I. vernonioides*, September 29; 2 females and 2 males on *I. vernonioides* October 2; 2 females and 1 male on *I. vernonioides*, October 9; 1 female on *H. grandiflora*, October 10; 1 male on *G. sarothrae*, October 13; 1 female on *I. vernonioides*, October 15; 1 female and 1 male on *I. vernonioides*, October 16; 1 male on *Ericameria palmeri*, October 18. The holotype and allotype are in the collection of Prof. P. H. Timberlake of the Citrus

TABLE XVII. Summary of Flower Records for *Melissodes appressa*.

Plant Data			Records of <i>M. appressa</i>			
FAMILY	Number of genera	Number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae:						
<i>Isocoma</i> spp.	1	2	48	107	33	140
<i>Gutierrezia</i> spp.	1	3	54	58	29	87
<i>Heterotheca</i> sp.	1	1	20	22	5	27
Other genera	10	11	23	19	40	59
Other families (3)	3	3	3	0	3	3
Totals	16	20	148	206	110	316

Experiment Station, Riverside, California. Paratypes are in the collections of P. H. Timberlake, The California Academy of Sciences, San Francisco, the U. S. National Museum, Washington, D. C., the Snow Entomological Museum of the University of Kansas, Lawrence, and in the author's collection.

*Distribution.* *M. appressa* is known only from California (Fig. 29). It has been collected from August 14 to November 10, but chiefly in September and October. In addition to the type material, 187 females and 117 males have been studied from the localities listed below.

CALIFORNIA: Altadena; Anaheim; Antioch; Benicia; Blythe; Cortago; Cushinberry Springs; Davis; Dos Palos; Elkhorn Ferry, Yolo Co.; Firebaugh; Gazelle; Highland (E. of), San Bernardino Co.; Inyo Mts., Inyo Co.; Ivanpah, San Bernardino Co.; Los Angeles Co.; McCloud, Siskiyou Co.; Millbrae; Morongo Valley; Riverside; Sacramento; Santa Ana River (near Yorba Linda); Sierraville; Standish (4 miles W.); Turlock; Victorville; Vina, Tehama Co.

*Flower Records.* *Alyssum maritimum*, *Aster* sp., *A. exilis*, *Centromadia pungens*, *Croton californica*, *Ericameria palmeri*, *Grindelia californica*, *Gutierrezia californica*, *G. lucida*, *G. sarothrae*, *Helianthus annuus*, *Heliotropium oculatum*, *Heterotheca grandiflora*, *Isocoma acradenia*, *I. vernonioides*, *Lessingia glandulifera*, *Melilotus alba*, *Pluchea camphorata*, *Senecio* sp., *Solidago anfinis*, *S. occidentalis*.

*Melissodes (Eumelissodes) pullatella*, n. sp.

This is a small dark species from Oregon known only in the female sex. *M. pullatella* seems to be closely related to *M. lutulenta*. However, it is difficult to assess the affinities of *pullatella* with the males still unknown. It is similar to *lutulenta* in size and sculpturing, but is much darker in the color of the vestiture. Specifically, *pullatella* females have the scopal hairs partly or entirely brown, and most of the vestiture of the head, thorax, and abdomen dark brown.

*Female.* Measurements and ratios: N, 14; length, 10-11 mm.; width, 3.5-4.0; wing length,  $M = 2.87 \pm 0.105$  mm.; hooks in hamulus,  $M = 11.14 \pm 0.177$ ; flagellar segment 1/segment 2,  $M = 1.85 \pm 0.019$ .

Structure and color: Integumental color as in *subagilis* except wing membranes slightly infumate, especially apically. Structure and sculpture as in *subagilis* except as follows: clypeal surface shiny, unshagreened or extremely slightly so; galeae tessellate; max-

illary palpal ratio about 3.0:3.0:2.6:1.0, minute fifth segment may be present (present in holotype); metasomal tergum 1 punctate in basal three-fifths, punctures shallow, surface dulled by reticular shagreening, apical area impunctate, with small, relatively impunctate, anterolateral lobes; tergum 2 with basal area punctures separated mostly by half to one puncture width, surface shiny, interband zone punctures sparse, with scattered large punctures and more abundant minute punctures, separated mostly by more than three puncture widths, but irregular, apical area impunctate or with several widely separated punctures near distal pubescent band, surfaces apical and interband areas moderately dulled by fine reticulotransverse shagreening; tergum 3 similar to 2 but interband zone punctures more abundant; pygidial plate with rounded apex.

Hair: Head dark brown. Thorax usually entirely dark brown (holotype) occasionally ochraceous on metanotum, dorsal and posterior surfaces propodeum, and just behind tegulae. Metasomal vestiture usually entirely dark brown to black (holotype), rarely with tergum 1 with long basal hairs partly ochraceous, tergum 2 with basal tomentum partly pale ochraceous, and tergum 2 with distal pubescent band interrupted medially, not reaching apical margin laterally; tergum 3 with distal band not interrupted medially, not reaching apex; tergum 4 with distal band apical. Legs dark brown except as follows: scopal hairs pale brown to brown, usually paler medially on tibiae (holotype), occasionally pale ochraceous medially on tibiae and medioproximally on basitarsi.

*Type Material.* The holotype female and eight female paratypes were collected August 12, 1937, on *Grindelia* sp., at five miles east of Tangent, Oregon, by H. A. Scullen. An additional five female paratypes from Oregon are as follows: Corvallis: 1 female, September 15, 1909, J. C. Bridwell; 1 female, August 29, 1924, H. A. Scullen; 1 female, July 22, 1925, D. A. Wilbur. Shedd: 2 females, August 5, 1924, H. A. Scullen (Fig. 33). The holotype is in the collection of the Oregon State College at Corvallis. Paratypes are in the collections of Oregon State College, the U. S. National Museum, Washington, D. C., the Snow Entomological Museum of the University of Kansas at Lawrence, and in the author's collection.

*Melissodes (Eumelissodes) pexa*, n. sp.

This small species is closely related to *M. limbus* and to *M. brevipyga*. The female resembles that of *limbus* in the dark hairs of the apical areas of terga 2 and 3, but differs from the *limbus* female in having distinct round punctures in the interband zone of tergum



2 and minute but distinct punctures in the apical areas of terga 2 and 3. This female also resembles that of *humilior* from which it differs by the shiny galeae. The male resembles that of *verbesinarum* and *humilior* in having yellow maculae on the mandibular bases, a pale labrum, and shiny galeae, and is like the male of *verbesinarum* (but unlike *humilior*) in having a thick band of appressed hairs across the apex of the first tergum. The male of *pexa* differs from that of *verbesinarum* in the mesoscutum being more densely punctate and in having a broad, short pygidial plate much as in *brevipyga*.

*Female.* Measurements and ratios: N, 3; length, 10-11 mm.; width, 3-4 mm.; wing length,  $M = 2.87 \pm 0.252$  mm.; hooks in hamulus,  $M = 12.67 \pm 0.333$ ; flagellar segment 1/segment 2,  $M = 2.23 \pm 0.029$ .

Structure and color: Integumental color as in *limbus* except eyes gray. Structure and sculpture as in *limbus* except as follows: clypeus with apicomedian carina absent (allotype) or weak; mesoscutum with posteromedian area punctate, punctures separated by half to one or slightly more puncture widths; metasomal tergum 1 basally with large shallow punctures separated mostly by half to one puncture width, apical area impunctate, with anterolateral lobes sparsely punctate; tergum 2 with interband zone punctures small, deep, separated mostly by one puncture width or less, apical area with minute but distinct punctures about twice diameter of appressed hairs arising from them; tergum 3 like 2 but apical area punctures more abundant.

Hair: Vestiture as in *limbus* except as follows: vertex of head with dark brown hairs abundant; mesoscutal hairs closely decumbent; tergum 1 with anterolateral lobes of apical area with abundant, short, closely appressed, simple, dark brown hairs.

*Male.* Measurements and ratios: N, 4; length, 9-10 mm.; width, 2.5-3.0 mm.; wing length,  $M = 2.79 \pm 0.219$  mm.; hooks in hamulus,  $M = 11.50 \pm 0.289$ ; flagellar segment 2/segment 1,  $M = 6.29 \pm 0.189$ .

Structure and color: Integumental color as in *verbesinarum* except as follows: labrum brown with white basomedial spot one-third to one-half area of labrum in size; mandibular base yellow (holotype) or with triangular yellow spot. Structure as in *subagilis* (and *verbesinarum*) except as follows: minimum length first flagellar segment about one-seventh or one-eighth maximum

length second segment; maxillary palpal ratio about 1.7:1.0:1.2:1.2; pygidial plate as broad near base as long or slightly broader. Sculpture as in female except as follows: tergum 1 with minute punctures almost to apical margin; terga 2-4 with apical areas impunctate. Terminalia as in *agilis*, but gonostylus not capitate, short; sternum 8 with apex entire, not emarginate or only slightly so, ventral tubercle not reaching apex, slightly bidentate.

Hair: Vestiture as in *verbesinarum* except as follows: mesoscutal hairs decumbent; terga 2, 3 and 4 often with pale brown, suberect hairs in apical areas, in holotype white.

*Type Material.* The holotype male from Villa Ahumada, Chihuahua, México, was collected June 28, 1947, on *Lepidium alysoides* by C. D. Michener. The allotype female from Paila, Coahuila, México, was collected August 21, 1947, by C. D. Michener. Three male and two female paratypes are as follows: MEXICO: 3 males from Villa Ahumada, Chihuahua, August 14, 1951, H. E. Evans. ARIZONA: 1 female from Winslow, Navajo Co., August 6, 1950, and 1 female from Joseph City, Navajo Co., August 6, 1950, J. W. MacSwain (Fig. 32). The holotype and allotype are in the collection of the American Museum of Natural History, New York City. Paratypes are in the collections of the University of California at Berkeley, the Snow Entomological Museum of the University of Kansas at Lawrence, and in the author's collection.

*Melissodes (Eumelissodes) monoensis*, n. sp.

This small species is closely related to *M. appressa*. The female of *monoensis* is scarcely distinguishable from that of *appressa*. However, the *monoensis* females have shorter flagellar segments 3 to 9 and have longer mesoscutal hairs which are more or less acute and not short and blunt-tipped as in females of *appressa*. The male of *monoensis* is distinctive in its short antennae which resemble the antennae of the subgenus *Tachymelissodes*. In *monoensis* males the minimum length of the first flagellar segment is one-fifth to one-half the maximum length of the second segment and the flagellum barely reaches the first metasomal tergum in repose.

*Female.* Measurements and ratios: N, 2; length, about 11 mm.; width, about 3.5 mm.; wing length, 2.78-3.11 mm.; hooks in hamulus, 12; flagellar segment 1/segment 2, 2.13-2.19.

Structure and color: Integumental color as in *appressa* except as follows: eyes dark gray; apex of second flagellar segment and segments 3-10 yellow to red below.

Structure and sculpture as in *appressa* except as follows: clypeal punctures smaller but crowded, apicomedial carina distinct, surface slightly dulled by fine irregular shagreening; supraclypeal area shiny, with fine irregular shagreening; galeae above shiny but with fine reticular shagreening; maxillary palpal ratio about 2.8:2.0:1.6:1.0; third flagellar segment with length equal to about four-fifths maximum width, segments 4 to 9 all distinctly shorter than broad; mesoscutum without impunctate posteromedian area (or this area very small); metasomal tergum 2 with basal area punctures separated by half to one puncture width, interband zone moderately dulled by reticular shagreening.

Hair: Head white with abundant brown on vertex. Thorax white laterally; scutellum brown fringed with white; mesoscutum with posteromedian dark brown patch somewhat less than twice size of scutellar dark area, hairs suberect, long, not blunt-tipped; tegulae without brown. Metasomal vestiture as in *appressa* except as follows: tergum 1 with small anterolateral lobes of apical area with short, closely appressed, dark brown, simple hairs; tergum 2 with apical area half as long as distal pale band medially, with one or two rows of subappressed, brown, simple hairs just distad of distal pale band, distal band touching apical margin only at extreme sides; tergum 3 like 2 but apical area not so broad.

*Male.* Measurements and ratios: N, 19; length, 8.5-11 mm.; width, 2.5-3.5 mm.; wing length,  $M = 2.98 \pm 0.179$  mm.; hooks in hamulus,  $M = 11.10 \pm 0.194$ ; flagellar segment 2/segment 1,  $M = 2.21 \pm 0.046$ .

Structure and color: Integument black except as follows: clypeus yellow except black spots at tentorial pits and reddish-brown apical margin; flagella yellow beneath, reddish brown above; mandible with apical half red; eyes gray; tarsi dark red to brown; tegulae piceous to reddish brown; wing membranes colorless or slightly yellowed, veins red to brown; marginal areas of terga 1-6 hyaline, colorless.

Antennae barely reaching first metasomal tergum in repose; minimum length first flagellar segment equals two-fifths to one-half maximum length second segment, penultimate flagellar segment about half as broad as long or shorter; maxillary palpal ratio about 2.5:2.5:2.0:0.75. Sculpture as in female except as follows: clypeal punctures indistinct; metasomal tergum 1 with basal four-fifths with deep round punctures separated mostly by one puncture width or less, somewhat sparser medially; terga 2-4 with interband zones



similarly punctate, surfaces moderately shiny, with exceedingly fine, sparse shagreening.

Gonostylus not capitate, broader in basal two-thirds than at apex, with minute hairs; gonocoxite with blunt hairs admixed with acute on inner surface near apex. Sternum 7 with median plate large, with abundant short hairs ventrally, with an inner, posterior angle, with neck short and broad. Sternum 8 as in *opuntiella* (*Tachymelissodes*) but with more abundant, shorter hairs at apex and a more prominent ventral carina which is not bilobed but bluntly rounded.

Hair: Grayish white except as follows: yellow to orange on inner surfaces tarsi and hind tibiae and ochraceous on last two metasomal terga. Apical pale pubescent bands on terga 2-5 consist of short, highly plumose hairs, bands on terga 2 and 3 often not reaching apices of terga medially, especially on tegum 2 and especially in worn specimens, otherwise metasomal vestiture as in *appressa*.

*Type Material.* The holotype male, allotype female and one female paratype from Bentons Crossing, Mono County, California, were collected July 7, 1935, by F. R. Platt (Fig. 33). Thirty-two paratype males from Bentons Crossing, California, are as follows: 9 males, September 9, 1935; 23 males, September 9, 1935, M. A. Cazier and F. R. Platt. One male paratype from Hot Creek, Mono Co., was collected August 21, 1954, on *Chrysothamnus* sp. by J. Lattin. The holotype and allotype are in the collection of Prof. P. H. Timberlake of the Citrus Experiment Station, Riverside, California. Paratypes are in the collections of P. H. Timberlake, the American Museum of Natural History, New York City, the Snow Entomological Museum of the University of Kansas, Lawrence, the U. S. National Museum, Washington, D. C., the University of California at Berkeley, and in the author's collection.

*Melissodes (Eumelissodes) microsticta* Cockerell

*Melissodes microsticta* Cockerell, 1905, in Viereck, *et al.* Canadian Ent., vol. 37, pp. 319-321; 1906, Trans. Amer. Ent. Soc., vol. 32, pp. 76, 113; Criddle, Curran, Viereck and Bucknell, 1924, Rept. Ent. Soc. Ontario, vol. 33, p. 99.

This is a small distinctive species related to the *menuachus* group, but not closely related to any single species. The males are distinctive in having the flagella dark brown below except for a small pale spot on each segment after the second and in having the clypeus infumate posteriorly. The females are small dark bees

with shagreened galeae, dark flagella, dark inner surfaces hind basitarsi, and a narrowly interrupted distal pale band on tergum 2. The females have the dorsal thoracic hairs blunt-tipped and erect, giving them a clipped appearance.

*Female.* Measurements and ratios: N, 20; length, 9-11 mm.; width, 3-4 mm.; wing length,  $M = 3.04 \pm 0.135$  mm.; hooks in hamulus,  $M = 12.80 \pm 0.268$ ; flagellar segment 1/segment 2,  $M = 1.86 \pm 0.019$ .

Structure and color: Integument black except as follows: apical half of mandible and distitarsi rufescent; eyes bluish to greenish gray; flagellar segments 3-10 dark reddish brown to black below; wing membranes slightly infumate, brownish, veins black; tergum 1 narrowly hyaline apically; tegulae piceous; tibial spurs yellow to ochraceous.

Clypeus shaped as in *coreopsis*, with large, shallow, irregular punctures separated mostly by half a puncture width, surface dulled by reticular shagreening, apicomedian carina distinct, usually half as long as clypeus or longer; supraclypeal area shiny, shagreening, if present, delicate; lateral areas vertex with small punctures separated by half to three puncture widths, surface shiny; galeae dulled above by reticular shagreening at least in apical halves, occasionally unshagreened except near tips; maxillary palpal ratio about 2.5:2.5:2.5:1.0; second flagellar segment slightly shorter than broad above. Mesoscutum with posteromedian area punctures separated by one-half to four puncture widths, peripherally punctures separated mostly by one-half to one puncture width, surface shiny, unshagreened; scutellum similar but punctures more crowded; mesepisterna with punctures separated mostly by half a puncture width or slightly more, surface shiny; propodeal surfaces dulled by dense tessellation, dorsal surface irregularly reticulorugose. Metasomal tergum 1 with basal three-fifths medially with round punctures separated mostly by one-half to one puncture width, apical area impunctate, surface shiny, extremely finely reticulotransversely shagreened; tergum 2 with basal area with small round punctures separated mostly by one puncture width, surface unshagreened, interband zone with small punctures separated mostly by one to three puncture widths, surface slightly dulled by reticulotransverse shagreening, apical area with small punctures in basal half equal to twice diameter of hairs arising from them, surface as in tergum 1; tergum 3 like 2 but interband zone punctures more abundant and apical area shorter; tergum 4 like 3 but apical area absent;

pygidial plate V-shaped, pointed apically, sides straight, slightly longer than broad at base.

Hair: Head pale ochraceous to yellow with abundant brown on vertex. Thorax white to pale ochraceous laterally; mesoscutum ochraceous to yellow with large posteromedian dark brown area extending forwards to a transverse line at anterior margins of tegulae; scutellum dark brown fringed with ochraceous; tegulae dark brown. Metasomal tergum 1 ochraceous basally, anterolateral lobes of apical area with short, subappressed, simple dark brown hairs; tergum 2 pale ochraceous basally, distal pubescent band ochraceous, narrowly interrupted medially by brown hairs, connected to basal pale band at extreme sides, interband zone with erect to suberect, dark brown, bristlelike hairs, apical area with subappressed to suberect, long, simple, dark brown hairs except in narrow glabrous apicomedian area; tergum 3 similar to 2 but basal tomentum dark brown, distal pale band uninterrupted medially and reaching apex of tergum at least in lateral fourths, and apical area shorter and reduced to almost absent; tergum 4 like 3 but apical area absent, occasionally with dark brown apical fringe in median fourth or less; terga 5 and 6 dark brown, tergum 5 occasionally with small ochraceous lateral tufts; sterna brown to ochraceous laterally. Legs ochraceous except as follows: fore and middle tarsi, outer-apical surfaces fore and middle tibiae, and basitibial plates brown; inner surfaces hind basitarsi dark brown to black; inner surfaces hind tibiae yellow.

*Male.* Measurements and ratios: N, 20; length, 8-12 mm.; width, 2.3-3.5 mm.; wing length,  $M = 2.91 \pm 0.180$  mm.; hooks in hamulus,  $M = 11.30 \pm 0.242$ ; flagellar segment 2/segment 1,  $M = 5.71 \pm 0.143$ .

Structure and color: Integument black except as follows: apical half of mandible and distitarsi rufescent; flagellar segments 3-11 reddish brown to black below with small round ventrolateral rufescent spot on each; clypeus yellow with brown apical margin and black posterior third to two-thirds; eyes dark gray to bluish or greenish gray; wing membranes slightly infumate to colorless or slightly milky, veins dark reddish brown to black; tegulae often rufescent; metasomal terga with apical areas hyaline, colorless to yellowish brown.

Clypeus as in *corcopsis*; minimum length first flagellar segment equals about one-fifth to one-seventh maximum length second segment, penultimate segment less than three times as long as



minimum width, flagellum reaching pterostigma in repose; maxillary palpal ratio about 7:6:6:1; sternum 6 with subapical oblique carinae indistinct or absent. Sculpture as in female except as follows: galeae often unshagreened except near tips; tergum 1 with basal five-sixths or more punctate; terga 3-5 similar to 2 but apical areas progressively shorter; terga 2-5 with interband zones with slightly larger punctures and apical areas virtually impunctate. Terminalia as in *agilis*; spatha short, less than 3 times as long as broad (Figs. 115-117).

Hair: Head white to pale ochraceous with abundant brown on vertex. Thorax as in female but pale hairs usually white and mesoscutal dark patch smaller, usually no more than twice size of scutellar dark area. Metasomal tergum 1 white basally and to apex at sides, apicomediaally with short, simple, dark brown hairs to apex; tergum 2 white basally, distal pale band white, reaching apex and connected to basal pale band at extreme sides, medially subequal in length to apical area, interband zone with suberect to erect, white to brown, bristlelike hairs, apical area with long, subappressed to suberect, dark brown hairs; terga 3-5 similar to 2 but basal tomentum brown, interband zones often with some diffuse white pubescence, apical areas shorter or absent; terga 6 and 7 yellow to pale brown; sterna yellow to white. Legs white except inner surfaces tarsi yellow.

*Bionomics.* *M. microsticta* is an oligolege of the Compositae. Out of a total of 60 collections (65 females and 39 males) bearing floral data, 55 collections (61 females and 28 males) were from some species of composite. However, no single genus seems to be preferred. In the Pacific Coast parts of the range, the genera *Aster*, *Solidago*, *Erigeron*, *Gutierrezia*, and *Chrysothamnus* were most often visited by these bees, whereas in the Utah-Wyoming area *Grindelia*, *Helianthus* and *Solidago* were the most frequently visited genera.

*Type Material.* The holotype male of *microsticta* from Vancouver Island, British Columbia, Canada, is in the collection of the Philadelphia Academy of Sciences, Philadelphia, Pennsylvania (Type No. 10407).

*Distribution.* *M. microsticta* ranges from British Columbia east to Saskatchewan and south to California, Utah and Texas (Fig. 36). It has been collected from June 1 to October 11, but mainly in July and August. In addition to the holotype 332 females and

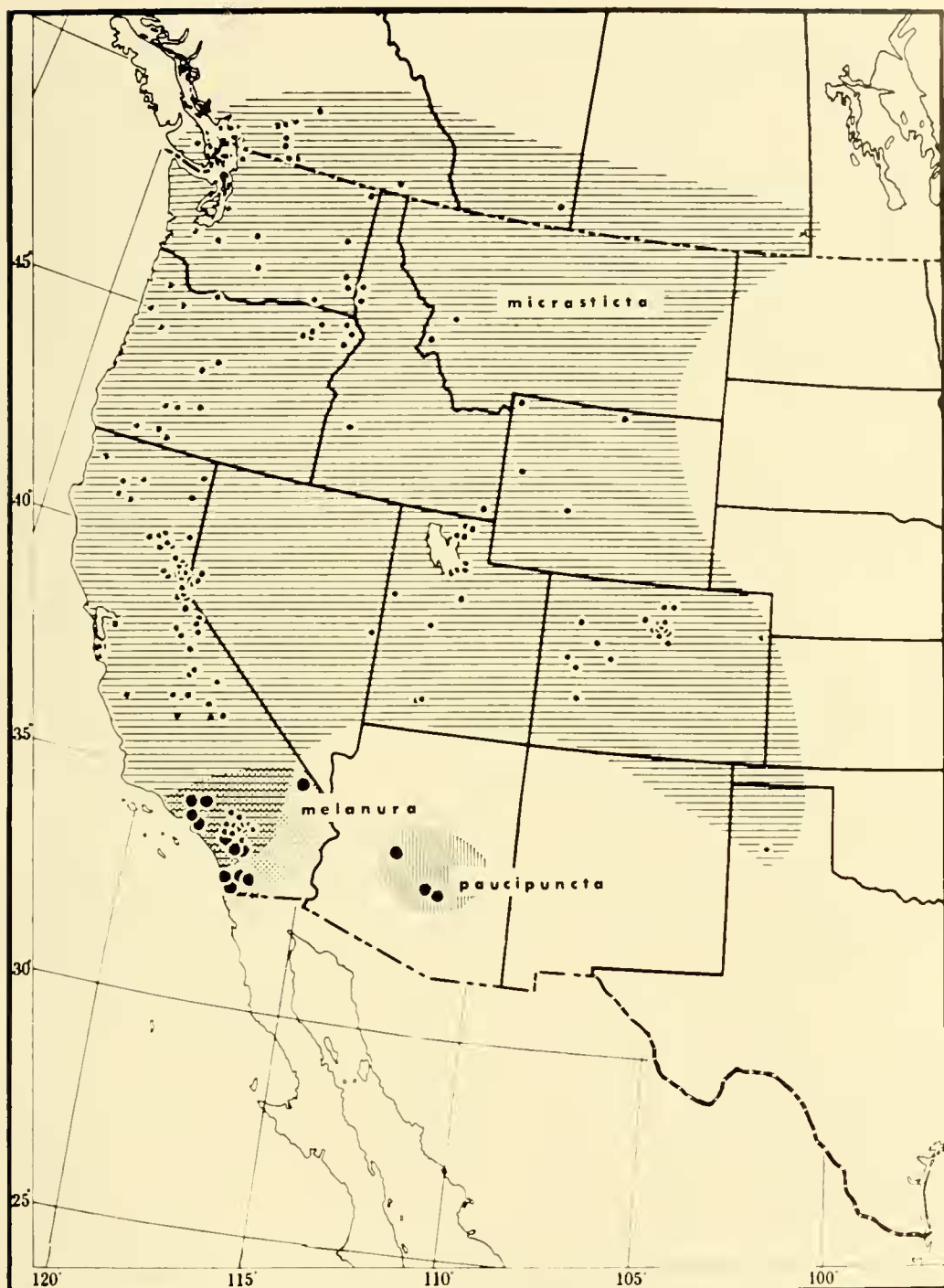


FIG. 36. Map showing the known distributions of *M. (Eumelissodes) microsticta* Cockerell, *M. (E.) melanura* (Cockerell), and *M. (E.) paucipuncta* LaBerge.

319 males have been examined from the localities listed below (including the type locality).

CALIFORNIA: Alta Mesa; Antioch; Bardon Flats; Big Bear Valley; Big Pine Camp, Inyo Co.; Blairsden, Plumas Co.; Bluff Lake, San Bernardino Mts.; Boca, Nevada Co.; Bridge Creek Camp, Lassen

Co.; Buck Creek, Modoc Co.; Butte Meadows, Butte Co.; Butterfly Valley, Plumas Co.; Calpine, Sierra Co.; Camp Lake, Tuolumne Co.; Carson Pass; Cisco; Cuyanoca (3.3 miles S.); Dodge Ridge, Tuolumne Co.; Donner Lake, Placer Co.; Dunsmuir; Echo Lake, Eldorado Co.; Eleanor Lake, Tuolumne Co.; Fallen Leaf Lake, Eldorado Co.; Felton Station, Santa Cruz Co.; Florence Lake, Fresno Co.; Giant Forest, Tulare Co.; Glacier Lodge (Big Pine), Inyo Co.; Gold Lake, Sierra Co.; Grout Creek, San Bernardino Mts.; Hobart Mills (and 7 miles N.), Nevada Co.; Hope Valley, Alpine Co.; Huntington Lake, Fresno Co.; Idyllwild; Independence Lake, Sierra Co.; Inyo Mts.; Kings River Canyon, Fresno Co.; Laguna Mt.; Lake Almanor, Plumas Co.; Lake Forest (Lake Tahoe); Lake Tahoe; Leevining; Lloyds, Tulare Co.; Meadow Valley, Plumas Co.; Mill Creek, San Bernardino Mts.; Mineralking; Mono Hot Springs, Fresno Co.; Old Station, Shasta Co.; Onion Valley, Plumas Co.; Pinecrest, Tuolumne Co.; Pine Knot, Bear Lake, San Bernardino Co.; Quincy (4 miles W.); Rathbon Creek, San Bernardino Co.; Riverside; Robinson Creek, San Bernardino Mts.; Sagehen (near Hobart Mills); Santa Ana River, San Bernardino Co.; Sequoia National Park; Shaver Lake, Fresno Co.; Sierraville; Sky Forest, San Bernardino Mts.; South Fork Camp, San Bernardino Mts.; Summit Camp, Lassen Co.; Trinity Center; Trinity River Camp, Trinity Co.; Valley of the Falls; Webber Lake, Sierra Co.; Yallao Lake, Tahoe Co.; Yosemite National Park; Yuba Pass, Sierra Nevada.

COLORADO: Aspen; Boulder; Boulder Canyon; Boulder Co.; Cederedge (5 miles N.); Fort Collins; Glenwood Springs; Granby Res., Grand Co.; Jim Creek (near Boulder); Meeker; Mesa (8 miles S.); Nederland; Peaceful Valley; Pingree Park; Poudre Canyon (W. of Fort Collins); Ridgway; Science Lodge (W. of Boulder); Tolland; Ward; Wray. IDAHO: Cub River Canyon; Franklin; Lewiston; Moscow; Paris Canyon. MONTANA: Bonner; Missoula. NEVADA: Baker; Mt. Rose, Washoe Co.; Purdy, Washoe Co.; Reno; Summit (Mt. Rose Highway); Verdi. OREGON: Anara Creek, Klamath Co.; Antelope Mt., Harney Co.; Anthony Lake, Blue Mts.; Bend; Chemult (8 miles S.); Cornucopia Creek; Crater Lake Park (near Headquarters and Ple Bridge Meadow); Elgin (3 miles S.); Ely Mt. Pass, Klamath Co.; Enterprise; Estacada (Bedford Point Lookout); Forest Grove; Grande Ronde; Hood River; Jennings Lodge; Klamath Falls; La Grande (5 miles N. and 4 miles S.); Lake of the Woods, Klamath Co.; Lick Creek Res., Wallowa National Forest; Marys Peak; Medford; Mt. Ashland; Prineville; Sheep Mt. Road,



Grant Co.; Silver Creek Park, Marion Co.; Silver Lake; Summitt Prairie; Three-sisters (Scott Lake); Wallowa Lake. TEXAS: Canyon. UTAH: Allen Canyon; Bryce Canyon; Delta; Farmington; Lake View; Logan; Logan Canyon; Magna; Mt. Nebo; Mt. Timpanogos; Murray; Petersboro; Salt Lake City; Settlement Canyon, Tooele Co.; Soldier Swamp; Vivian Park; Wellsville; Willard. WASHINGTON: Bellingham; Buckley; Colfax; Coupeville; Liberty; Metaline Falls; Mt. Constitution; Pullman; Rochester; Seattle; Spokane; Walla Walla; Whidby Island; White Rock Spring, Cascade Mts.; Yakima. WYOMING: Bondurant; Sheridan; South Pass; Yellowstone National Park. *Canada*. ALBERTA: Medicine Hat. BRITISH COLUMBIA: Agassiz; Boston Bar (5 miles S.); Comox (Pt. Holmes); Crescent; Kamloops; Kerameos; Merritt; Newgate; Nicola; Oliver; Peachland; Royal Oak; Selkirk Mts. (Beaver Mouth); Sidney; Summerland; Vancouver; Vancouver Island; Vernon; Victoria; Wallhackin. SASKATCHEWAN: Maryfield.

*Flower Records.* *Artemesia* sp., *Aster* sp., *A. adscendus*, *A. canescens*, *A. delectabilis*, *Calyptridium umbellatum*, *Carduus* sp., *Cichorium* sp., *C. inybus*, *Chrysopsis* sp., *C. villosus*, *Chrysanthamnus* sp., *C. nauscous*, *C. n. consimilis*, *Corethrogyne* sp., *Cryptantha intermedia*, *Erigeron stenophyllus*, *Eriogonum* sp., *Grindelia* sp., *G. squarrosa*, *Gutierrezia californica*, *G. sarothrae*, *Haplopappus* sp., *Helenium bigelovii*, *Helianthus* sp., *Hemizonia wrighti*, *Malvastrum paniculatum*, *Penstemon* sp., *Phacelia* sp., *P. humilis*, *Senecio ionophyllus*, *Solidago* sp., *S. occidentalis*, *Sphaeralcea fasciculata*.

*Melissodes (Eumelissodes) paulula*, n. sp.

This small species is related to *M. microsticta*. The male of *paulula* is distinctive in that flagellar segments 4 to 11 (and often 3) have the upper-outer surfaces longitudinally depressed or flattened and very shiny (much as in certain species of the subgenus *Callimelissodes*). The male has a partially darkened clypeus and shiny galeae. The female is less easily recognized. The female of *paulula* is small, with shiny galeae, fox-red pale mesoscutal hairs, dark brown hairs on tegulae, in apical areas of terga 2 and 3 and on inner surfaces of the hind basitarsi, and has the distal pale band of tergum 2 interrupted medially with the two resulting lateral parts forming oblique fasciae tapering medially.

*Female.* Measurements and ratios: N, 20; length, 8-10 mm.; width, 3-4 mm.; wing length,  $M = 2.75 \pm 0.111$  mm.; hooks in hamulus,  $M = 11.80 \pm 0.117$ ; flagellar segment 1/segment 2,  $M = 1.92 \pm 0.002$ .

Structure and color: Integumental color as in *microsticta* but wing membranes colorless to slightly milky and tergum 1 with apical area usually rufescent.

Structure and sculpture as in *microsticta* except as follows: clypeus with apicomedian carina absent or indistinct; galeae above shiny, unshagreened except near tips, with coarse punctation; maxillary palpal ratio about 2.5:1.7:1.7:1.0, last segment often shorter; mesoscutum with posteromedian area punctures separated mostly by one to four puncture widths, surface often with fine reticular shagreening, but scarcely dulled; metasomal tergum 2 with basal area punctures separated by half to one puncture width, surface shiny, interband zone punctures deep, large, separated mostly by half to one puncture width (often by 2 widths medially), surface slightly dulled by reticular shagreening, apical area with small punctures in basal half scarcely more than twice diameter of hairs arising from them, surface shiny; tergum 3 similar to 2 but apical area shorter, interband zone absent or almost so; tergum 4 like 3 but apical area absent; pygidial plate V-shaped but with apex more rounded than in *microsticta*, longer than basal breadth.

Hair: Vestiture as in *microsticta* except as follows: mesoscutum with pale hairs dark ochraceous to fox-red, dark posteromedian patch not reaching a transverse line at anterior margins of tegulae, not larger than twice area of scutellar dark patch; thoracic hairs blunt-tipped giving a clipped appearance above; metasomal pubescent bands white to pale ochraceous; tergum 2 with distal pale band interrupted medially with lateral parts tapering mesad to form oblique lateral fasciae, interband zone with brown hairs appressed to suberect, apical area with dark brown hairs closely appressed; tergum 3 similar to 2 but basal tomentum dark brown, interband zone virtually lacking, distal pale band broad, uninterrupted, reaching apex laterally; tergum 4 without brown apicomedia; terga 5 and 6 with lateral white tufts; legs with inner surfaces hind basitarsi dark brownish red to black.

*Male.* Measurements and ratios: N, 20; length 8-10 mm.; width, 2.0-2.5 mm.; wing length,  $M = 2.62 \pm 0.124$  mm.; hooks in hamulus,  $M = 10.45 \pm 0.198$ ; flagellar segment 2/segment 1,  $M = 6.25 \pm 0.089$ .

Structure and color: Integumental color as in *microsticta* except as follows: flagellum yellow to red below except segment 1; wing membranes colorless to slightly milky; tegulae piceous; tergal apices piceous.

Structure as in *microsticta* except as follows: minimum length first flagellar segment equals about one-sixth (holotype) maximum length second segment, penultimate segment more than three times as long as minimum width, flagellum in repose surpassing pterostigma, segments 4 to 11 (and often 3) with upper-outer surfaces longitudinally depressed or flattened and extremely shiny (these depressions located at conjunction of yellow and dark brown areas of each segment); maxillary palpal ratio about 2.2:2.0:2.0:1.0. Sculpture as in female except as follows: clypeal punctures shallow; mesoscutum often with impunctate posteromedian area; tergum 1 punctate almost to apical margin but punctures in apical third smaller and separated mostly by two or more puncture widths; tergum 2 with basal area punctures separated by half to one or slightly more puncture widths, interband zone punctures separated mostly by one to two puncture widths, apical area usually with minute punctures almost to apical margin; terga 3-5 similar to 2 but apical areas progressively shorter to absent and interband zone punctures more abundant. Sternum 6 with subapical oblique carinae strong, converging apically but not meeting. Terminalia as in *agilis* and *microsticta*.

Hair: Vestiture as in *microsticta* except as follows: tegulae often without brown; tergum 2 with distal pale band subequal to or shorter than apical area medially, interband zone hairs suberect to erect, dark-brown; terga 6 and 7 pale to dark brown, paler laterally.

*Bionomics.* *M. paulula* is an oligolege of the Compositae and seems to prefer the genera *Isocoma*, *Gutierrezia*, and *Solidago* in that order. The floral data are summarized in Table XVIII.

*Type Material.* Holotype male, allotype female, and seven male and seven female paratypes from Sacramento, California, were collected by Lawrence Bruner, October 3, 1916. In addition, fourteen female and three male paratypes were collected by Bruner in 1916 in the same locality as follows: September 18, 3 females; October 1, 8 females and 1 male; October 6, 3 females and 2 males. The holotype and allotype are in the collection of the Nebraska State Museum, Entomology Division, University of Nebraska in Lincoln. Paratypes are in the collections of the Nebraska State Museum, the Snow Entomological Museum of the University of Kansas, Lawrence, the U. S. National Museum, and in the author's collection.

*Distribution.* *M. paulula* is known only from California except for one male from the state of Washington (Fig. 37). It has been collected from July 12 to November 9, but mainly in September and



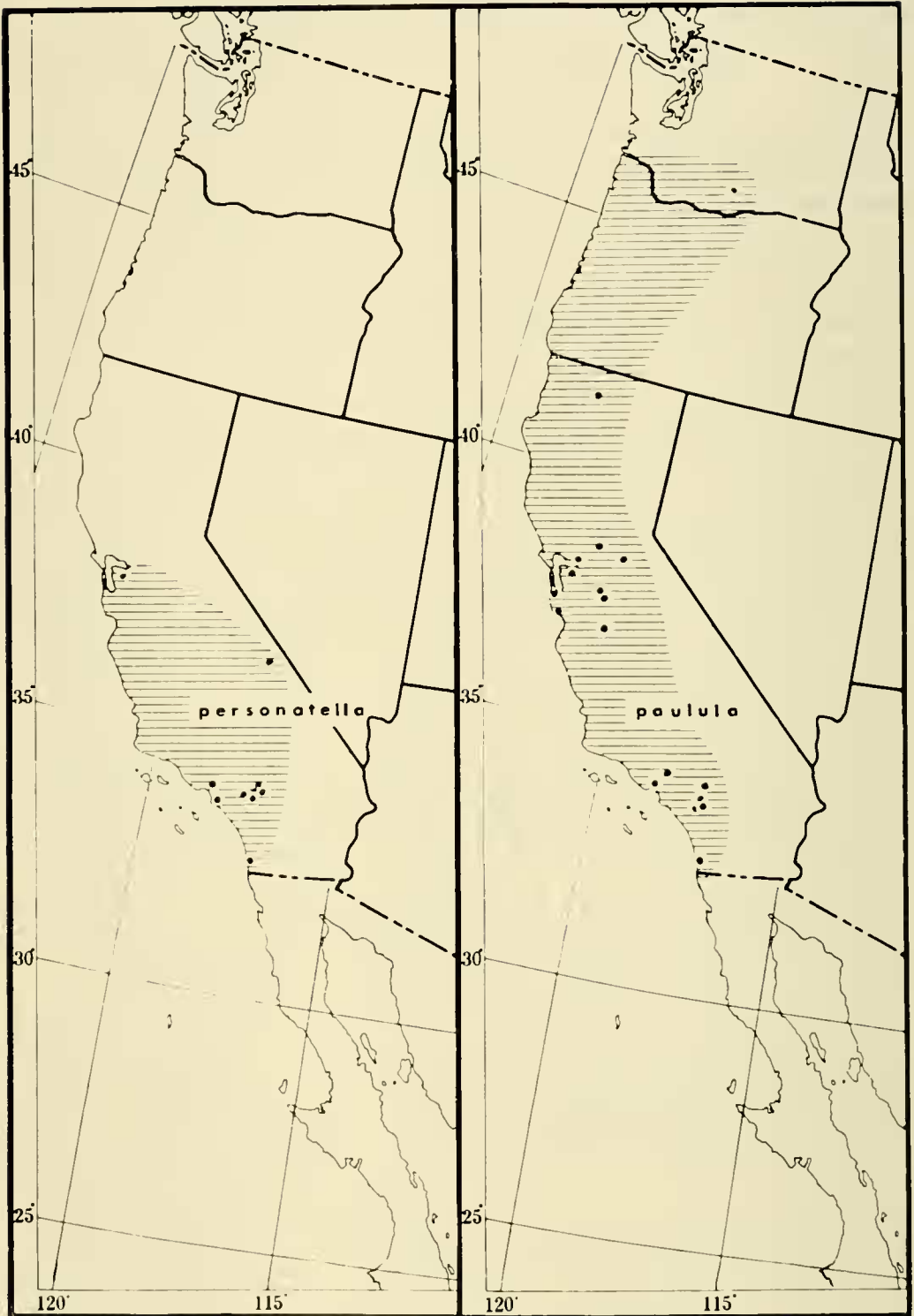


FIG. 37. Map showing the known distributions of *M. (Eumelissodes) personatella* Cockerell and *M. (E.) paulula* LaBerge.

TABLE XVIII. Summary of Floral Data for *Melissodes paulula*.

Plant Data			Records of <i>M. paulula</i>			
FAMILY	Number of genera	Number of species	Number of collections	Number of females	Number of males	Total number of bees
Compositae:						
<i>Isocoma</i> spp.	1	2	46	91	48	139
<i>Gutierrezia</i> spp.	1	2	45	47	26	73
<i>Solidago</i> spp.	1	2	31	39	45	84
Other genera	9	10	17	13	15	28
Other families (2)	2	2	3	0	4	4
Totals	14	18	142	190	138	328

October. In addition to the type material, 258 females and 133 males have been examined from the localities listed below (including the type locality).

CALIFORNIA: Antioch; Arcadia; Davis; Dos Palos; (6.5 miles E.); Felton Station, Santa Cruz Co.; Gazelle, Siskiyou Co.; La Sierra, Riverside Co.; Los Angeles Co.; Mission Valley; Modesto; Murphys, Calaveras Co.; Palo Alto; Redlands; Riverside; Riviera; Sacramento; San Diego; Turlock; Warm Spring (2 miles S. and 5 miles N.); Warners Ranch; Victorville. WASHINGTON: Toppenish.

*Flower Records.* *Baccharis emoryi*, *Croton californicus*, *Ericameria palmeri*, *Erigeron canadense*, *Eriogonum fasciculatum*, *E. gracile*, *Gutierrezia* sp., *G. californica*, *G. sarothrae*, *Helianthus annuus*, *Heliotropium oculatum*, *Heterotheca grandiflora*, *Isocoma acradenia*, *I. vernonioides*, *Pluchea camphorata*, *Salsola kali*, *Senecio* sp., *S. douglasii*, *Solidago* sp., *S. californica*, *S. occidentalis*.

# *Melissodes (Eumelissodes) personatella* Cockerell

*Melissodes personatella* Cockerell, 1901, Canadian Ent. vol. 33, p. 297; 1902, Entomologist, vol. 32, p. 75; 1903 Psyche, vol. 10, p. 77; 1906, Trans. Amer. Ent. Soc., vol. 32, p. 75.

This small species is closely related to *M. microsticta*. The female can be distinguished from that of *microsticta* by the pale distal band of tergum 2 being uninterrupted medially, the unsha-

greened galeae, and the orange-red to red hairs of the inner surfaces of the hind basitarsi. The male of *personatella* can be distinguished from that of *microsticta* by the paler flagella without depressions as in *paulula* and with longer penultimate segments than in *microsticta*, the completely black clypeus (almost always so), and the shiny galeae.

*Female*. Measurements and ratios: N, 20; length, 9-11 mm.; width, 3.5-4.0 mm.; wing length,  $M = 2.85 \pm 0.399$  mm.; hooks in hamulus,  $M = 13.10 \pm 0.176$ ; flagellar segment 1/segment 2,  $M = 2.01 \pm 0.003$ .

Structure and color: Integumental color as in *microsticta* except as follows: flagellar segments 3 to 10 red below; wing membranes colorless to slightly milky; terga 1-4 with apical areas usually slightly rufescent; tegulae often rufescent.

Structure and sculpture as in *microsticta* except as follows: clypeal punctures large posteriorly and separated by less than half a puncture width, anteriorly half the diameter, apicomedian carina weak but usually present, surface unshagreened or only delicately so; supraclypeal area shiny; lateral areas vertex with punctures minute, separated mostly by one to four puncture widths or more, surface shiny; galeae unshagreened above except near tips; maxillary palpal ratio about 3.5:3.0:2.5:1.0; mesoscutum with postero-median impunctate area reduced to extremely small size or absent, punctures separated mostly by one to two puncture widths postero-medially except in impunctate area when present, surface slightly dulled by fine reticular shagreening; metasomal tergum 2 with basal area punctures minute, separated mostly by one puncture width, surface moderately dulled by fine reticular shagreening, interband zone punctures small, separated mostly by one to two puncture widths, surface moderately dulled by reticular shagreening, apical area impunctate or with minute sparse punctures, shiny, reticulo-transversely shagreened; tergum 3 similar to 2 but apical area usually reduced to about one-third width of tergum and half length of that of tergum 2; pygidial plate V-shaped with well-rounded apex.

Hair: Vestiture as in *microsticta* except as follows: thorax with pale hairs of dorsum yellow to fox-red, mesoscutal dark patch not extending forwards to a transverse line at anterior margins of tegulae and usually no larger than twice scutellar dark area, hairs of dorsum erect and blunt-tipped giving clipped appearance; metasomal tergum 1 with apical area with abundant, short, dark brown,



closely appressed, simple hairs; tergum 2 with distal pale band pale ochraceous, uninterrupted, about twice length of apical area medially; tergum 3 similar but distal pale band reaching apical margin in lateral thirds or more, apical area shorter than in tergum 2; tergum 4 without apicomedian brown hairs; terga 5 and 6 with large pale lateral tufts; sterna yellow to yellow-brown medially and white apically and laterally; legs as in *microsticta* but inner surfaces hind basitarsi yellow-red to red.

*Male.* Measurements and ratios: N, 20; length, 9-11 mm.; width, 2.5-3.0 mm.; wing length,  $M = 2.83 \pm 0.116$  mm.; hooks in hamulus,  $M = 11.95 \pm 0.158$ ; flagellar segment 2/segment 1,  $M = 6.27 \pm 0.093$ .

Structure and color: Integumental color as in *microsticta* except as follows: flagellar segments 3-11 red below; clypeus entirely black (in two specimens a small apicomedian yellow spot less than one-fourth area of clypeus present and in a third specimen clypeus mostly yellow, but blackened along posterior margin); wing membranes colorless to slightly milky; tergal apices colorless to yellowish.

Structure as in *microsticta* except as follows: minimum length first flagellar segment equals about one-sixth maximum length second segment, penultimate segment slightly more than three times as long as broad, in repose flagellum surpasses pterostigma; maxillary palpal ratio about 2.7:2.0:2.0:1.0. Sculpture as in female except as follows: clypeal punctures smaller; tergum 1 with punctures almost to apex but in apical third minute and separated mostly by two or more puncture widths; tergum 2 with basal area punctures separated mostly by half to two puncture widths, surface shiny, slightly shagreened, apical area impunctate; terga 3-5 similar to 2 but interband zone punctures more crowded and apical areas progressively shorter to absent. Terminalia as in *agilis* and *microsticta* (Figs. 120-121).

Hair: Vestiture as in *microsticta* except as follows: metasomal tergum 1 with apicomedian brown simple hairs long, subappressed to suberect; tergum 2 with distal pale band subequal to or longer than apical area medially, interband zone hairs long, suberect to erect, dark brown, bristlelike, apical area hairs long, suberect, dark brown, bristlelike; terga 3-5 similar to 2 but brown basally and apical areas shorter to absent; terga 6 and 7 yellowish to dark ochraceous.

*Bionomics.* *M. personatella* seems to be an oligolege of the composite genus *Gutierrezia*. Out of 100 available collections (106 females and 40 males) with floral data, a total of 85 collections (96 females and 35 males) were made from *Gutierrezia*. The remaining 15 collections were made from seven other composite genera and one from a plant of another family. Among these last 15 collections only *Ericameria* (Compositae) is of any importance. A single female has been seen from Guatemala. As *personatella* is otherwise known only from Californian material, it is assumed that it occurs in intervening areas as well. However, the Guatemalan record may represent a female of a new species closely related to *personatella*.

*Type Material.* The holotype male of *personatella* from La Jolla, California, collected in August by T. D. A. Cockerell, is in the collection of the U. S. National Museum (U. S. N. M. Type No. 13189), Washington, D. C.

*Distribution.* *M. personatella* is known from California, and by a single female from Guatemala (Fig. 37). It has been taken from May 30 to November 19, but chiefly in September and October. In addition to the holotype, 116 females and 42 males have been examined from the localities listed below.

CALIFORNIA: Altadena; Antioch; Big Bear Lake, San Bernardino Mts.; Bluff Lake, San Bernardino Mts.; La Jolla; Los Angeles Co.; Panamint Mts.; Inyo Co.; Ripley (7 miles S.); Riverside; Santa Ana Canyon, San Bernardino Co.; Santa Monica. GUATEMALA: Jicaro.

*Flower Records.* *Ericameria palmeri*, *Eriogonum gracile*, *Gutierrezia californica*, *G. sarothrae*, *Hagardia squamosa*, *Helianthus* sp., *Hemizonia paniculata*, *Heterotheca grandiflora*, *Isocoma veronioides*, *Palofoxia linearis*.

*Melissodes (Eumelissodes) melanura* (Cockerell)

*Exomalopsis melanurus* Cockerell, 1916, Pomona Jour. Ent. Zool., vol. 8, p. 59; Bray, 1917, Pomona Jour. Ent. Zool., vol. 9, p. 95.

*Melissodes melanura*, Michener, 1951, in Museback *et al.* Hymenoptera of America north of Mexico, synoptic catalog, U. S. Dept. Agric., Agric. Monogr. No. 2, p. 1226.

This small species is related to *M. microsticta*. The female is readily identified by the long galeal hairs which are hooked near the tips, the densely tessellate galeae, the broad metasomal bands, and the small size. The male of *melanura* has a black clypeus as in *personatella*, densely tessellate galeae, metasomal bands as in the female, long flagella which are strongly crenulate especially in the

last four to six segments, and strong subapical carinae on the sixth sternum.

*Female.* Measurements and ratios: N, 20; length 8-10 mm.; width, 3.0-3.5 mm.; wing length,  $M = 2.41 \pm 0.086$  mm.; hooks in hamulus,  $M = 11.30 \pm 0.128$ ; flagellar segment 1/segment 2,  $M = 1.98 \pm 0.017$ .

Structure and color: Integumental color as in *microsticta* except as follows: eyes bluish to greenish gray; flagellar segments 3-10 red below; wing membranes milky, veins dark reddish brown; tegulae and tergal apices usually rufescent.

Structure and sculpture as in *microsticta* except as follows: clypeal surface shiny, unshagreened; galeae opaque, densely tessellate, with abundant long hairs hooked near tips; mesoscutum with posteromedian area impunctate or nearly so, elsewhere punctures large, separated by one puncture width or less, surface shiny; metasomal tergum 1 with basal half or slightly more with coarse punctures separated mostly by half a puncture width or slightly more, apical area with minute wide-spread punctures except near apex; tergum 2 with basal area punctures separated by half to one puncture width, surface shiny, interband zone with small punctures regularly spaced by half to one puncture width, surface moderately dulled by fine reticular shagreening, apical area impunctate or with minute punctures; tergum 3 like 2 but apical area equals no more than one-third width of tergum and shorter than in 2; tergum 4 like 3 but lacking apical area; pygidial plate with apex rounded.

Hair: Head white on lower parts to ochraceous above with abundant brown on vertex. Thorax white laterally to ochraceous above except mesoscutum with posteromedian dark brown patch about twice size of scutellar dark patch; hairs of dorsum short, blunt-tipped, giving clipped appearance. Metasomal tergum 1 white to pale ochraceous basally, apical area, and especially anterolateral lobes of apical area, with short, closely appressed, dark brown, simple hairs; tergum 2 with basal white band connected at extreme sides to distal white band, distal band uninterrupted, subequal in length to interband zone medially (interband zone of about same length across entire tergum) and twice length of apical area, interband zone hairs abundant, appressed to subappressed, dark brown, apical area hairs sparse, appressed to subappressed, dark brown; tergum 3 similar to 2 but basal tomentum dark brown and apical area reduced to one-third width of tergum or less and shorter; tergum 4 like 3 but lacking apical area; terga 5 and 6 brown to dark



brown with pale lateral tufts; sterna yellow or white medially, white apically and laterally. Legs as in *microsticta* but inner surfaces hind basitarsi yellow to red and scopae white.

*Male.* Measurements and ratios: N, 20; length, 7-10 mm.; width 2-3 mm.; wing length,  $M = 2.32 \pm 0.132$  mm.; hooks in hamulus,  $M = 9.60 \pm 0.184$ ; flagellar segment 2/segment 1,  $M = 6.83 \pm 0.983$ .

Structure and color: Integumental color as in *microsticta* except as follows: clypeus from entirely black (13 specimens) to two-thirds yellow (one specimen), usually less than half yellow, if at all; flagellar segments 2-11 yellow to red below; eyes greenish to bluish gray; wing membranes milky; tergal apices hyaline and colorless to translucent brown.

Structure as in *microsticta* except as follows: minimum length first flagellar segment equals about one-seventh maximum length second segment, penultimate segment more than three times as long as broad, flagellum in repose surpasses pterostigma, last four to six segments strongly crenulate above; maxillary palpal ratio about 6:6:4:1; sixth sternum with weak subapical oblique carinae. Sculpture as in female except as follows: tergum 1 punctate almost to apical margin but punctures become smaller and sparser in last fifth; terga 2-4 with interband zone punctures separated by one to two puncture widths or slightly more. Terminalia as in *agilis* and *microsticta* (Figs. 122-123).

Hair: Vestiture as in female except as follows: galeal hairs abundant but not hooked near tips; tergum 1 with apical third to two-fifths with abundant, long, subappressed, dark brown, simple hairs; tergum 2 with distal pale band slightly longer than apical area medially; terga 2-5 with interband zone hairs long, suberect to subappressed, bristlelike, dark brown, and apical areas progressively shorter, with suberect to subappressed, brown hairs; terga 6 and 7 brown. Legs as in *microsticta*.

*Bionomics.* There is not sufficient data to warrant a statement concerning oligolecty in *M. melanura*. However, the hooked galeal hairs of the female suggest that *melanura* is adapted to some particular flower or group of flowers for sources of pollen.

*Type Material.* The holotype female of *melanura* from Claremont, California, collected by Baker, is in the collection of the American Museum of Natural History, New York City.

*Distribution.* Except for one male from Nevada, all known specimens of *melanura* are from California (Fig. 36). It has been taken

from August 12 to October 10. In addition to the holotype, 54 females and 25 males have been examined from the localities listed below.

CALIFORNIA: Altadena; Antioch; Boquet Canyon, Angeles National Forest; Dutch Flat, San Jacinto Mts.; Felton Station, Santa Cruz Co.; Green Valley, Angeles National Forest; Hemit Valley, San Jacinto Mts.; Idyllwild; Julian; Keen Camp (3 miles E.), Riverside Co.; Los Angeles Co.; Mill Creek, San Bernardino Co.; Mission Valley; Riverside; San Diego; San Diego Co.; Warner Springs (5 miles N.). NEVADA: "Nev."

*Flower Records.* *Aster* sp., *Corethrogyne* sp., *C. bernardina*, *Erigeron* sp., *Eriogonum virgatum*, *Gutierrezia californica*, *G. sarothrae*, *Lessingia glandulifera*, *Solidago* sp.

*Melissodes (Eumelissodes) terminata* n. sp.

Although this species is represented by a single male from Baja California, I do not hesitate to describe it, as it is very distinctive. It is related to *microsticta* and *personatella* and has the partially blackened clypeus so common in that group. It can be easily recognized by the last two flagellar segments being black and contrasting with the preceding segment which is yellow below.

*Male.* Measurements and ratio: N, 1; length, about 10 mm.; width, about 3 mm.; wing length, 3.27 mm.; hooks in hamulus, 12; flagellar segment 2/segment 1, 6.78.

Structure and color: Integumental color as in *microsticta* except as follows: clypeus black with subapical trilobed yellow macula covering slightly more than half of clypeus; mandibles and labrum black; flagellum yellow-orange below, dark brown above except first segment entirely brown and last two segments black; tergal apices translucent brown.

Structure as in *microsticta* except as follows: minimum length of first flagellar segment about six and two-thirds maximum length second segment, penultimate segment more than three times as long as broad, flagellum in repose surpassing pterostigma; maxillary palpal ratio about 3.5:3.0:3.0:1.0; sternum 6 with subapical oblique carinae sharp, distinct, curved, slightly less than twice as long as distance between their tips, with well-developed median sulcus, apex emarginate. Sculpture as in *microsticta* except terga 2-5 with interband zone punctures separated mostly by one to two puncture widths and surfaces dulled by reticular shagreening. Sternum 7 with median plates with a transverse ventral ridge

supporting several rows of long hairs clearly separating the apical puberulent plate from the basal, shiny, apubescent neck region. Sternum 8 with apicomedian ventral tubercle sharply pointed, apical margin strongly emarginate medially with the two lateral apical lobes with sharp apices. Genital capsule as in *agilis*, gonostyli slightly capitate, with abundant short hairs especially basally.

Hair: Head and thorax as in *microsticta* but brown hairs of vertex less abundant and tegulae without brown. Metasomal vestiture as in *microsticta* except as follows: tergum 1 with apicomedian area with few simple brown hairs; tergum 2 with interband zone hairs white, apical area hairs white and sparse; terga 6 and 7 pale ochraceous; sternal hairs yellow medially to white basally. Legs as in *microsticta*.

*Type Material.* The holotype male from 32 miles south of Tijuana, Baja California, Mexico, collected on July 31, 1934, by Basinger, is in the collection of Prof. P. H. Timberlake of the Citrus Experiment Station, Riverside, California.

*Remarks.* *M. terminata* was first recognized as a new species by P. H. Timberlake. The blackened apical flagellar segments, so distinctive in this specimen, may be merely a monstrosity. However, there are no other indications that this is the case on this specimen.

*Melissodes (Eumelissodes) micheneri*, n. sp.

This is a distinctive, medium-sized bee from California. It is not closely related to the foregoing species, but, perhaps, is most closely related to *M. melanura*. The female can be recognized by the acutely pointed pygidial plate, the dulled galeae, and the relatively long second flagellar segments. The males are readily recognized by the dark antennae (as in *microsticta*), the black clypeus, the dull galeae, and the sharp and long subapical carinae of the sixth sternum. This species is named in honor of Dr. C. D. Michener of the University of Kansas who collected the holotype and to whom the author is indebted for time and advice during the progress of this revision.

*Female.* Measurements and ratios: N, 20; length, 10-13 mm.; width, 3.5-4.5 mm.; wing length,  $M = 3.62 \pm 0.123$  mm.; hooks in hamulus,  $M = 13.90 \pm 0.239$ ; flagellar segment 1/segment 2,  $M = 1.60 \pm 0.002$ .

Structure and color: Integumental color as in *microsticta* except as follows: eyes gray; wing membranes colorless, veins black.



Structure and sculpture as in *microsticta* except as follows: clypeal punctures round, separated by half a puncture width, surface and bottoms of punctures tessellate; supraclypeal area moderately dulled by irregular shagreening; galeae dulled above by fine tessellation; maxillary palpal ratio about 2.7:2.3:1.7:1.0; second flagellar segment distinctly longer than maximum width (ratio of width/length about 5/6 in allotype); mesoscutum with posteromedian area punctures separated mostly by one to two puncture widths, surface often with fine reticular shagreening but not dull; scutellum with punctures small, separated mostly by one to three puncture widths, surface as in mesoscutum; metasomal tergum 1 with basal four-fifths with small round punctures separated mostly by half to two puncture widths; tergum 2 with basal area punctures separated by one puncture width or more, surface slightly dulled by delicate shagreening, interband zone punctures minute, shallow and indistinct, separated mostly by two to four puncture widths, surface dulled by fine dense reticulotransverse shagreening, apical area impunctate; tergum 3 similar to 2 but interband zone punctures denser and more distinct; pygidial plate V-shaped with apex acutely pointed and sides usually slightly concave to straight, longer than basal breadth.

Hair: Head pale ochraceous to yellow with abundant dark brown on vertex. Thorax pale ochraceous to yellow laterally; scutellum dark brown medially, yellow peripherally; mesoscutum with dark brown posteromedial area no larger than twice scutellar dark area and usually smaller, peripherally yellowish-ochre to dull rufescent; tegulae with dark brown. Metasomal tergum 1 pale ochraceous basally, glabrous apically; tergum 2 pale ochraceous to white basally, distal pale band pale ochraceous, composed of long pubescence, not interrupted medially, almost reaching apex of tergum laterally, interband zone with long, erect, pale ochraceous hair, apical area (unless worn) with long, simple, dark brown, suberect hairs; tergum 3 similar to 2 but basal tomentum dark brown and distal pale band reaching apex in lateral thirds; tergum 4 like 3 but apical area absent; terga 5 and 6 dark brown with pale lateral tufts at least on 5; sterna dark brown, white laterally and along apical margin of penultimate sternum. Legs as in *microsticta*.

*Male.* Measurements and ratios: N, 20; length, 9-13 mm.; width, 2.5-3.5 mm.; wing length,  $M = 3.21 \pm 0.162$  mm.; hooks in hamulus.  $M = 12.35 \pm 0.131$ ; flagellar segment 2/segment 1,  $M = 7.45 \pm 0.100$ .

Structure and color: Integumental color as in *microsticta* except as follows: clypeus entirely black; wing membranes colorless, veins dark brown; tergal apices piceous.

Structure as in *microsticta* except as follows: minimum length first flagellar segment about one-ninth to one-tenth (holotype) maximum length second segment, penultimate segment slightly more than three times as long as broad, in repose surpassing pterostigma; maxillary palpal ratio about 2.7:2.3:2.0:1.0; sternum 6 with distinct, sharp, subapical carinae converging distally, each carina about twice length of distance between their tips, sternum flat between carinae, without well-marked median sulcus, but often shiny medially. Sculpture as in female except as follows: metasomal tergum 1 with punctures almost to apical margin but smaller and sparser in apical fifth; terga 3-5 similar to 2 but apical areas progressively shorter. Terminalia as in *agilis* but gonostylus extremely slender, long, more than  $\frac{1}{2}$  length of gonocoxite, hairless; sternum 7 with median plate produced apicolaterally; sternum 8 with ventral tubercle not bidentate.

Hair: Head and thorax as in female but pale hairs of thoracic dorsum usually pale ochraceous. Metasomal vestiture as in female except as follows: tergum 1 with apical area with abundant, sub-erect, simple, dark brown hairs; tergum 2 with distal pale band shorter and interband zone hairs dark brown; terga 3-5 similar to 2 but apical areas progressively shorter (often lacking completely on 5); terga 6 and 7 brown; sterna yellow to brown medially, pale ochraceous to white laterally. Legs pale ochraceous to white except inner surfaces tarsi yellow.

*Remarks.* *M. micheneri* is an oligolege of the Compositae and seems to prefer the genera *Chrysothamnus* and *Chrysopsis*. Out of a total of 20 collections available with floral data (100 females and 76 males), 11 were taken from *Chrysothamnus* (50 females and 11 males) and 9 from *Chrysopsis* (50 females and 65 males).

*Type Material.* The holotype male and allotype female from Mill Creek, San Bernardino Co., California, were collected by C. D. Michener, August 31, 1930. In addition, 44 female and 19 male paratypes from San Bernardino Co., California, are as follows: Forest Home (Mill Creek Canyon): 19 females and 3 males on *Chrysothamnus* sp., September 22, 1935, P. H. Timberlake; 3 males, August 22, 1953, J. C. Hall. Mill Creek: 1 male, September 1, 1930, C. D. Michener; 2 females, September 5, 1931, C. D. Michener. Also from Mill Creek collected by P. H. Timberlake; 7 males on *Chrysopsis*

*fastigiata*, August 15, 1934; 3 females and 4 males on *C. fastigiata*, August 24, 1936; 9 females and 1 male on *Chrysopsis villosa*, September 5, 1937; 2 females on *Chrysothamnus* sp., September 19, 1937; 1 female on *Chrysothamnus* sp., August 21, 1942; 3 females on *C. villosa*, August 21, 1942; 2 females on *Chrysothamnus* sp., September 10, 1945; 3 females on *C. villosa*, September 1, 1947. The holotype and allotype are in the Snow Entomological Museum of the University of Kansas, Lawrence. Paratypes are in the collections of the Snow Entomological Museum, P. H. Timberlake of the Citrus Experiment Station, Riverside, California, the University of California at Davis, the California Academy of Sciences, San Francisco, the U. S. National Museum, Washington, D. C., and in the author's collection.

*Distribution.* *M. micheneri* is known only from California (Fig. 32). It has been collected only in August and September. In addition to the type material, 64 females and 65 males have been examined from the localities listed below (this list includes the type localities).

CALIFORNIA: Big Trees, Calaveras Co.; Convict Lake, Mono Co.; Forest Home, Mill Creek Canyon; Mill Creek, San Bernardino Co.; Murphys, Calaveras Co.; Pinecrest, Tuolumne Co.; San Diego; Valley of Falls, San Bernardino Co.

*Flower Records.* *Chrysopsis fastigiata*, *C. villosa*, *Chrysothamnus* sp.

### *Melissodes (Eumelissodes) moorei* Cockerell

*Melissodes moorei* Cockerell, 1926, Ann. Mag. Nat. Hist., ser. 9, vol. 18, p. 624.

*M. moorei* is closely related to *M. micheneri*. The female of *moorei* differs from that of *micheneri* by the pygidial plate being rounded apically, the wings somewhat infuscated, the galeae having at least a few hairs bent or hooked near the tips, and small but distinct punctures in the apical areas of terga 2 and 3. This female also resembles that of *robustior*, but can be distinguished by the hooked galeal hairs and punctate tergal apices. The male of *moorei* has a black clypeus and dark flagella as in *micheneri*, but has the subapical carinae of sternum 6 only weakly developed and occasionally a small amount of yellow on the clypeus and somewhat paler flagella.

*Female.* Measurements and ratios: N, 19; length, 10-13 mm.; width, 4.0-4.5 mm.; wing length,  $M = 3.42 \pm 0.152$  mm.; hooks in



hamulus,  $M = 15.90 \pm 0.369$ ; flagellar segment 1/segment 2,  $M = 1.86 \pm 0.020$ .

Structure and color: Integumental color as in *microsticta* except eyes bluish to brownish gray. Structure and sculpture as in *microsticta* except as follows: clypeus with posteromedian punctures large, separated by half a puncture width, laterally and posteriorly smaller and extremely shallow, anteriorly shallow and extremely small, surface tessellate, especially peripherally and at bottoms of large punctures, apicomedian carina weak or absent; supraclypeal area with distinct reticular shagreening; galeae tessellate above, with abundant long hairs hooked or bent near tips (at least a few hooked); maxillary palpal ratio about 4.0:3.5:3.5:1.0; second flagellar segment about as long as broad or extremely slightly longer; mesoscutum, especially peripherally, with surface often dulled by fine reticular shagreening; metasomal tergum 1 medially with basal five-sixths punctate; tergum 2 with basal area punctures separated mostly by one puncture width or slightly more, surface reticularly shagreened, apical area with punctures three to four times width of hairs arising from them or more and separated mostly by two to three puncture widths, surface finely shagreened, shiny; tergum 3 similar to 2 but interband zone punctures smaller and apical area punctures more crowded; tergum 4 like 3 but apical area lacking; pygidial plate V-shaped, apex rounded, longer than broad.

Hair: Head and thorax as in *micheneri* except as follows: labrum often with brown; vertex with more abundant brown hairs; mesoscutal dark patch often twice as large as scutellar dark area or larger. Metasomal vestiture as in *micheneri* except as follows: tergum 1 with basal pale hairs decumbent and reaching apex medially, with long, suberect to subappressed, simple, dark brown hairs mixed with the pale along apical margin of punctate area; tergum 2 with distal pale band short, often narrowly interrupted medially, if not, then shorter than apical area, interband zone hairs suberect to erect, dark brown, apical area suberect brown hairs more abundant; tergum 3 similar to 2 but apical area shorter, distal pale band broader, uninterrupted, and not reaching apical margin laterally; tergum 4 like 3 but lacking apical area.

*Male.* Measurements and ratios: N, 20; length, 10-13 mm.; width, 3-4 mm.; wing length,  $M = 3.25 \pm 0.134$  mm.; hooks in hamulus,  $M = 14.45 \pm 0.411$ ; flagellar segment 2/segment 1,  $M = 6.39 \pm 0.113$ .

Structure and color: Integumental color as in *microsticta*, clypeus

usually entirely black, rarely with small yellow subapical strip less than one-tenth area of clypeus; flagella below usually somewhat reddened; eyes bluish to yellowish gray; tegulae piceous; tergal apices usually slightly translucent, yellowish brown to piceous.

Structure as in *microsticta* except as follows: minimum length first flagellar segment one-eighth to one-ninth maximum length second segment, penultimate segment slightly more than three times as long as broad, reaching pterostigma in repose, segments 3 or 4 to 10 crenulated by basal constrictions; maxillary palpal ratio about 3.6:3.2:3.2:1.0; sternum 6 with subapical carinae weakly developed, each carina blunt and much shorter than half distance between their tips, median shiny sulcus present. Sculpture as in female except as follows: tergum 1 punctate to within one-eighth of apex or less, last sixth of punctate area with punctures smaller and separated mostly by less than one puncture width; tergum 2 with interband zone punctures separated by one to three puncture widths, apical area punctures smaller and sparser; terga 3 to 5 similar to 2 but apical areas progressively shorter. Terminalia as in *micheneri* but gonostylus with minute hairs, sternum 7 with median plates as in *agilis* (not produced apicolaterally), and sternum 8 with ventral tubercle dark, sclerotized and bidentate apically (Figs. 124-125).

Hair: Vestiture as in *micheneri* except as follows: tergum 2 with distal pale band usually interrupted medially; terga 3-5 similar to 2 but apical areas progressively shorter (present on 5), basal tomentum brown and distal pale bands uninterrupted.

*Remarks.* Not enough data are available to make a firm statement regarding the flower preferences of *M. moorei*. However, the hooked galeal hairs of the female indicate that they are adapted to one or a few plants as sources of pollen. *M. moorei* females have been collected only on *Grindelia* and *Hemizonia* and no specimens have yet been taken on any but the Compositae.

*Type Material.* The holotype female of *moorei* from sand hills at Pacific Grove, California, collected by Cockerell on July 3, is in the collection of Prof. P. H. Timberlake of the Citrus Experiment Station, Riverside, California.

*Distribution.* *M. moorei* is known chiefly from the coastal area of California (Fig. 31). It has been collected from June 6 to September 24, chiefly in August and September. In addition to the holotype, 21 females and 40 males were examined from the localities listed below.

CALIFORNIA: Alpine Lake, Marin Co.; Bird Rock (near), Mon-

terey Coast; Dunsmuir; Encinitas; Grover City, San Luis Obispo Co.; Ingleside (Ocean Beach), San Francisco Co.; Los Angeles Co.; Mokelumne Hill; Mono Bay; Monterey; Naples; Pacific Grove, Monterey Co.; Palm City; Pinecrest; Pt. Pinos; Redondo Beach, Los Angeles Co.; San Francisco Co.; Santa Monica.

*Flower Records.* *Corethrogyne* sp., *Grindelia* sp., *G. platyphylla*, *Hemizonia peniculata*, *Heterotheca grandiflora*, *Solidago* sp.

*Melissodes (Eumelissodes) exilis*, n. sp.

This small species is closely related to *M. microsticta*. The female of *exilis* differs from that of *microsticta* in having the distal pale band of tergum 2 uninterrupted, the interband zone of tergum 2 with the surface dulled by dense shagreening, unshagreened galeae, and less brown hair on the mesoscutum. The male of *exilis* is like that of *microsticta* but has piceous tergal apices, longer penultimate flagellar segments and flagellum, and tergum 2 sculptured as in the female.

*Female.* Measurements and ratios: N, 3; length, about 11 mm.; width, about 4 mm.; wing length,  $M = 3.45 \pm 0.029$  mm.; hooks in hamulus,  $M = 13.00 \pm 0.577$ ; flagellar segment 1/segment 2,  $M = 4.86 \pm 0.105$ .

Structure and color: Integumental color as in *microsticta* except as follows: eyes dark bluish gray; tibial spurs ochraceous; tergum 1 piceous apically.

Structure and sculpture as in *microsticta* except as follows: clypeal punctures slightly smaller, crowded, apicomedian carina weak or absent; supraclypeal area slightly shagreened; galeae above unshagreened except near tips; tergum 1 with basal area punctures separated mostly by half to two puncture widths, surface dulled by dense reticulotransverse shagreening; tergum 2 with interband zone punctures no larger than those of basal area and separated by one to three puncture widths, surface opaque, dulled by dense reticulotransverse shagreening, apical area impunctate or with minute punctures basally, surface somewhat dulled by fine dense reticulotransverse shagreening; terga 3 and 4 similar to 2 but apical areas shorter or absent; pygidial plate as in *microsticta*.

Hair: Head pale ochraceous to yellow except as follows: labrum brown; vertex with abundant dark brown; pale hairs on or near vertex fox-red. Thorax ochraceous laterally to fox-red above except as follows: scutellum dark brown fringed with yellow; mesoscutum with dark brown posteromedian patch no more than twice area of



scutellar dark patch (less in allotype); tegulae with dark brown. Metasomal tergum 1 dark ochraceous basally, glabrous apically; tergum 2 pale ochraceous basally, distal pale band ochraceous, uninterrupted medially, as long as apical area medially, interband zone with long, relatively simple, suberect, pale ochraceous, bristle-like hairs, apical area with long, subappressed to suberect, dark brown hairs at least basally; tergum 3 similar to 2 but basal tomentum dark brown, apical area shorter and often distal pale band reaching apex at extreme sides; tergum 4 like 3 but apical area reduced to small apical triangular area one-fourth width of tergum (allotype) or absent; terga 5 and 6 dark brown; sterna dark brown with ochraceous laterally. Legs as in *microsticta*.

*Male*. Measurements and ratios: N, 2; length, about 10 mm.; width, about 3 mm.; wing length, 2.74-3.07 mm.; hooks in hamulus, 10-11; flagellar segment 2/segment 1, 8.05-8.68.

Structure and color: Integumental color as in *microsticta* except as follows: flagellar segments 2-11 dark reddish brown below with small ventrolateral paler spots on each; eyes dark gray; tegulae piceous; tergal apices piceous except first extremely narrowly hyaline.

Structure as in *microsticta* except as follows: minimum length first flagellar segment equals about one-eighth maximum length second penultimate segment and more than three times as long as minimum width, flagellum in repose surpassing pterostigma; maxillary palpal ratio about 3.5:3.0:2.8:1.0. Sculpture as in female except as follows: basal four-fifths of tergum 1 punctate; terga 3-5 similar to 2 but with shorter apical areas. Terminalia as in *agilis* but gonostylus slender, short (about  $\frac{1}{3}$  length of gonocoxite or less), scarcely capitate and almost hairless, and sternum 8 with ventral tubercle not bidentate; spatha almost half as long as broad.

Hair: Vestiture as in *microsticta* except as follows: vertex of head with dark brown hairs more abundant; mesoscutal dark patch twice size of scutellar dark area, broader anteriorly than posteriorly; pale hairs of mesoscutum and upper mesepisterna yellow; terga 2 and 3 with distal pale bands shorter than apical areas; terga 4 and 5 with distal pale bands broader than apical areas; terga 6 and 7 dark brown; sterna yellow to white laterally.

*Type Material*. The holotype male and allotype female from 15 miles north of Tucson, Arizona, were collected by G. D. Butler on *Viguiera* sp., September 14-16, 1955. In addition, two females and one male paratype from Arizona are as follows: 2 females

from 15 miles north of Tucson, on *Aster* sp., September 14-16, 1955, G. D. Butler; 1 male from Tucson, on a yellow composite, September 14, 1955, G. D. Butler (Fig. 32). The holotype and allotype are the property of the University of Arizona but are deposited on indefinite loan in the Snow Entomological Museum of the University of Kansas, Lawrence. Paratypes are in the collection of the University of Arizona, Tucson, and in the author's collection.

*Melissodes (Eumelissodes) paucipuncta*, n. sp.

This small species is not closely related to any of the foregoing species. It has certain resemblances to members of the *microsticta* group, however, and so is treated here. The female is distinctive in the sparseness of the metasomal punctation: the first metasomal tergum has only sparse punctures separated by about three puncture widths in the basal third or less and very few elsewhere; the interband zones and apical areas of terga 2 and 3 are virtually impunctate. Furthermore, the scopal hairs of the female are only weakly branched and some sternal hairs seem to form an accessory scopa as described below. The male is distinctive in having sparsely punctate terga as in the female (but less so), short antennae not reaching the pterostigma in repose and with the penultimate segment less than three times as long as broad, and piceous tergal apices.

*Female.* Measurements and ratios: N, 2; length about 10 mm.; width about 3.5 mm.; wing length, 2.97-3.11 mm.; hooks in hamulus, 12; flagellar segment 1/segment 2, 1.80-1.85.

Structure and color: Integumental color as in *microsticta* except as follows: eyes greenish gray; flagellar segments 3-10 red below; wing membranes colorless.

Structure and sculpture as in *microsticta* except as follows: clypeus more protuberant, punctures well-spaced, separated by more than half a puncture width, posteromedially by as much as one or slightly more puncture width, surface unshagreened, apico-median carina weak; supraclypeal area punctate, shiny, irregularly shagreened; maxillary palpal ratio about 5.3:4.7:2.7:1.0; mesoscutum impunctate posteromedially, punctures surrounding impunctate area anteriorly to anterior ends of and within parapsidal lines (and slightly anterior to this medially) separated mostly by two or three puncture widths, peripherally punctures separated by one to two puncture widths, surface shiny; scutellum with small punctures separated by one to two puncture widths, surface shiny; propodeum

with dorsal surface impunctate medially, scattered small round punctures in lateral thirds, surface tessellate; metasomal tergum 1 with small punctures in basal third or less separated by two to five puncture widths, apical area impunctate; tergum 2 with basal area punctures minute, separated by one to two puncture widths, interband zone and apical areas impunctate; terga 3 and 4 similar to 2 but interband zone with several scattered punctures especially laterally near distal pale bands; pygidial plate apex rounded.

Hair: Vestiture as in *microsticta* except as follows: pale hair and pubescence white; tegulae without or with little brown; tergum 1 glabrous apically; tergum 2 with distal white band markedly interrupted medially, subequal in length (at ends of fasciae) to apical area, interband zone virtually bare, apical area and between fasciae of distal pale band with closely appressed, simple, brown hairs; tergum 3 like 2 but basal tomentum brown, distal white band only narrowly interrupted and longer than apical area, and interband zone with hair similar to apical area; tergum 4 like 3 but apical area reduced to small apicomedian triangle less than one-third width of tergum and almost glabrous; terga 5 and 6 with conspicuous white lateral tufts; sterna yellow to brown medially, white laterally, many long apicomedian hairs of first three sterna with tips curled (probably accessory scopal hairs). Legs as in *microsticta* except inner surfaces hind basitarsi yellow to red and scopal hairs with branches sparse (usually 2 or 3 on each side of rachis), long, curled near tips.

*Male.* Measurements and ratios: N, 2; length, about 11 mm.; width, about 3 mm.; wing length, 2.86-2.99 mm.; hooks in hamulus, 10; flagellar segment 2/segment 1, 4.52-4.92.

Structure and color: Integumental color as in *microsticta* except as follows: flagellar yellow beneath except first segment brown; eyes greenish gray; clypeus yellow except apical margin testaceous and dark maculae at tentorial pits; wing membranes clear, veins dark brown; tergal apices piceous or hyaline but smoky brown (as in allotype).

Structure as in *microsticta* except as follows: minimum length first flagellar segment equals one-sixth to one-seventh maximum length second segment, penultimate segment distinctly less than three times as long as minimum width, flagellum not reaching prestigma in repose; maxillary palpal ratio about 6.5:6.0:2.5:1.0. Sculpture as in female except as follows: tergum 1 with basal four-fifths with large shallow punctures separated by one to three puncture widths; terga 2-4 with interband zones with sparse, irregular-sized



punctures separated mostly by three or four puncture widths; tergum 5 similar but more punctate and apical area shorter. Sternum 6 with subapical oblique carinae very strong and sharp, each almost twice as long as distance between their apices. Terminalia as in *agilis* except as follows: gonostylus short (about  $\frac{1}{3}$  as long as gonocoxite), broad (almost half as broad as long), with minute hairs; sternum 7 with median plate with long neck and small, transverse apical plate which is glabrous ventrally, lateral plates small and weakly sclerotized; sternum 8 only slightly emarginate apically and with ventral tubercle acute, not bidentate.

Hair: Vestiture as in female except as follows: tergum 1 with basal four-fifths with sparse white hair; terga 2-5 with interband zones with sparse brown hairs (often ochraceous or white on tergum 2) suberect to erect, apical areas glabrous and progressively shorter; terga 3-5 with distal white band not interrupted medially; terga 6 and 7 dark brown; sterna yellow medially, white laterally; legs white with inner surfaces tarsi yellow.

*Bionomics.* The peculiar scopal hairs plus the probably accessory scopal hairs of the sterna of the female of *paucipuncta* suggest the adaptation to and oligolecty on flowers of *Opuntia* (Cactaceae). This is the only species of *Melissodes* in which the sternal hairs seem to be modified to aid in collecting of pollen, although these hairs must be of some service in this respect in other species.

*Type Material.* The holotype female from east of Thompson Arbor, Superior, Arizona, was collected May 15, 1954, on *Opuntia* sp., by G. D. Butler. The allotype male from four miles east of Apache Junction, Arizona, was collected May 15, 1954, by G. D. Butler. One paratype male was collected on *Bebbia* sp. by Butler at the same time and place as the allotype. One paratype female from ten miles northwest of Wickenburg, Arizona, was collected May 21, 1945, on *Opuntia* sp., by W. P. Cockerell. The holotype and allotype are the property of the University of Arizona but are on indefinite loan to the Snow Entomological Museum of the University of Kansas at Lawrence. One paratype (male) is in the collection of R. R. Snelling of Turlock, California and the other (female) is in the collection of P. H. Timberlake of the Citrus Experiment Station, Riverside, California.

*Melissodes (Eumelissodes) crocina*, n. sp.

This small brightly colored species from Guatemala and Honduras is known only in the female sex. The females of *crocina* can be readily distinguished from any other Central American species

(including Mexico) of *Eumelissodes* by the sharply pointed pygidial plate, the ferrugineous mesoscutal hairs, the densely punctate interband zone of tergum 2, and the shiny galeae. It seems to be related to the *microsticta* group of North America, specifically to *M. micheneri*.

*Female.* Measurements and ratios: N, 3; length, about 11 mm.; width, about 4 mm.; wing length,  $M = 2.83 \pm 0.200$  mm.; hooks in hamulus,  $M = 12.33 \pm 0.880$ ; flagellar segment 1/segment 2,  $M = 1.82 \pm 0.032$ .

Structure and color: Integumental color as in *microsticta* except as follows: clypeus with apicomedian area rufescent (holotype) or black; basitibiae and tibiae often rufescent (holotype); tegulae rufescent.

Structure and sculpture as in *microsticta* except as follows: clypeus with apicomedian carina distinct, about two-thirds as long as clypeus, punctures large, shallow, irregular laterally and apically; supraclypeal area dulled by reticular shagreening; lateral areas vertex with punctures more distinct, separated mostly by half to one puncture width or slightly more, surface shiny; galeae shiny above, unshagreened; maxillary palpal ratio about 3.3:2.0:2.0:1.0; mesoscutum with small impunctate posteromedian area, posterior to impunctate area punctures crowded, elsewhere separated mostly by half to one puncture width or slightly more; metasomal tergum 1 with punctures of basal three-fifths shallow; tergum 2 with basal area punctures large, round, deep, separated mostly by half a puncture width, surface shiny, interband zone punctures same size as those of basal area, very regular in size and spacing, separated mostly by half a puncture width or slightly more, surface dulled by coarse reticular shagreening, apical area with minute punctures separated by two to four puncture widths, surface moderately dulled by fine reticulo-transverse shagreening; tergum 3 similar to 2 but interband zone punctures smaller, apical area punctures more crowded, apical area restricted; pygidial plate V-shaped, apex acute.

Hair: Head white to pale ochraceous except abundant brown on vertex. Mesepisterna with ventral and lower-anterior surfaces brown, lower-lateral surfaces white to pale ochraceous, upper-lateral surfaces orange-red; metepisterna and propodeum white to pale ochraceous; scutellum brown medially, fringed with yellow or orange; mesoscutum with brown posteromedian patch equal to about twice scutellar dark area (holotype) or less, anteriorly and laterally dark ochraceous to bright orange-red; tegulae without

brown. Metasomal vestiture as in *microsticta* except as follows: tergum 2 with interband zone hairs appressed to subappressed, distal pale band may reach apex of tergum at extreme sides (holotype); tergum 3 like 2 but basal tomentum dark brown, distal pale band reaches apex in lateral fourths or less (not in holotype); tergum 4 with apical area absent or reduced to short broad medial apical triangular area (holotype); terga 5 and 6 dark brown, with few or no pale lateral hairs; sternal hairs brown, paler laterally. Legs as in *microsticta* except as follows: middle tarsi and outer surfaces fore and middle tibiae brown; inner surfaces hind basitarsi reddish brown; scopal hairs yellow, may be washed with brown medially (holotype) from basitibial plate to tip of tibiae, basitarsal scopal hairs at least half dark brown.

*Type Material.* The female holotype was taken at San Cristobál, Guatemala, in January. One female paratype was collected February-March, 1931, at Santa Emilia (Pochuta), Guatemala, by J. Becquaert. One female paratype was collected September 20, 1917, at Tegucigalpa, Honduras, by F. J. Dyer. The holotype is in the American Museum of Natural History, New York City. The paratypes are in the collections of the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, and the U. S. National Museum, Washington, D. C.

#### NOMINA DUBIA

The six names listed below are here considered to be *nomina dubia* since, so far as the author has been able to determine, the types of each have been lost or destroyed. Furthermore, the author has been unable to identify these species from the original descriptions which are too brief and without sufficient detail or figures.

*Melissodes americana* (Lepeletier), 1841, Hist. Nat. Ins. Hym., vol. 2, p. 92 (as *Macrocera americana*) (Carolina, Illinois).

*Melissodes cajennensis* (Lepeletier), 1841, Hist. Nat. Ins. Hym., vol. 2, p. 94 (as *Macrocera cajennensis*) (French Guiana).

*Melissodes pennsylvanica* (Lepeletier), 1841, Hist. Nat. Ins. Hym., vol. 2, p. 97 (as *Macrocera pennsylvanica*) (Pennsylvania).

*Melissodes philadelphia* (Lepeletier), 1841, Hist. Nat. Ins. Hym., vol. 2, p. 97 (as *Macrocera philadelphia*) (Pennsylvania).

*Melissodes atriventris* Smith, 1854, Cat. Hym. British Museum, vol. 2, p. 310 (North America).

*Melissodes intermedia* Cresson, 1872, Trans. American Ent. Soc., vol. 4, p. 278 (Texas).



ADDENDA

The following notes pertain to species or subgenera described in the previously published parts of this revision (LaBerge, 1956).

*Melissodes (Melissodes) colliciata* Cockerell

*Melissodes colliciata* Cockerell, 1910, Ann. Mag. Nat. Hist., ser. 8, vol. 5, p. 257.

*Melissodes elusa* LaBerge, 1956, Univ. Kansas Sci. Bull., vol. 47, part 2, p. 1061 (new synonymy).

Since the publication of the description of *M. elusa*, the author has had the opportunity of examining the holotype and cotype males of *M. colliciata* Cockerell which are in the collection of the Zoologische Museum der Humboldt Universität, Berlin (East), Germany. They are without doubt the same species and the name *elusa* must go into synonymy.

*Melissodes (Ecplectica) haitiensis*, n. sp.

This is a second species of the subgenus *Ecplectica* from the West Indies which brings the number of species belonging to this subgenus in the area covered by this revision to three. *M. haitiensis* is known from a single female, but is so distinctive as to merit recognition at this time. In the key to species (LaBerge, 1956, p. 1041) of *Ecplectica* and *Melissodes* s. str. (the species of these two subgenera being in the same key), *haitiensis* does not fall with the other two species of *Ecplectica*, but goes to *M. tessellata* (couplet 10, p. 1043) which it resembles closely. *M. haitiensis* can be readily distinguished from *tessellata* by the lack of the distal pale pubescent band of tergum 2 and by the hyaline, yellowish apical areas of terga 1 to 4. This last character plus the densely tessellate and opaque surfaces of the head, mesoscutum, scutellum and mesepisterna will separate *haitiensis* from all other species of the subgenera *Ecplectica* and *Melissodes*.

*Female*. Measurements and ratios: N, 1; length, about 13 mm.; width, about 4 mm.; wing length, 3.27 mm.; hooks in hamulus, 16; flagellar segment 1/segment 2, 2.28.

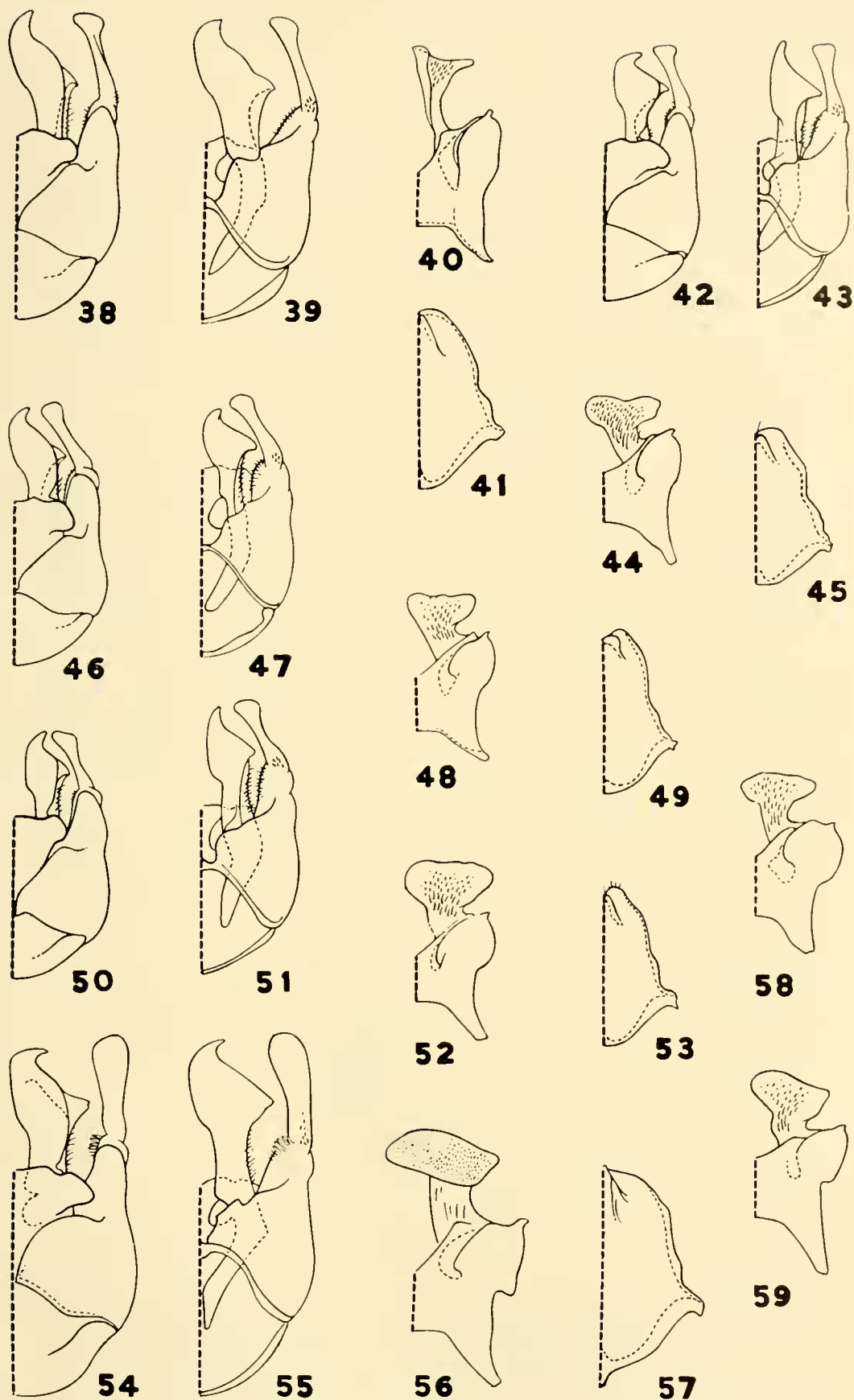
Structure and color: Integumental color black except as follows: mandibles, distitarsi, sterna rufescent; flagellar segments 3-10 and apex of 2 yellow below; eyes gray-brown; wing membranes slightly infumate, yellowish brown, veins dark brown; tegulae testaceous; tibial spurs white; terga 1-4 with apical areas hyaline, yellowish, shaded to brown posteriorly.

Clypeus flat, oculoclypeal distance less than half minimum width first flagellar segment, with small, shallow, round punctures, surface dulled by dense tessellation; supraclypeal area dulled by dense

tessellation; vertex with lateral areas with minute punctures separated by two to three puncture widths, opaque, tessellate; galeae above shiny, unshagreened; maxillary palpal ratio about 1.6:1.5:1.5:1.0. Mesoscutum with round shallow punctures separated by half to one puncture width peripherally and one to two puncture widths posteromedially; scutellar punctures slightly smaller and more crowded; mesepisternal punctures like peripheral mesoscutal punctures; thorax everywhere opaque, surfaces (and bottoms of punctures) dulled by dense regular tessellation. Metasomal tergum 1 with basal three-fifths with extremely shallow punctures separated mostly by one to two puncture widths, apically impunctate, surface opaque, dulled by fine, but extremely dense, reticulotransverse shagreening; tergum 2 with basal area punctures small, round, separated mostly by half a puncture width, surface shiny, interband zone with round punctures slightly larger than in basal area, separated by half a puncture width, surface opaque as in tergum 1, apical area with small punctures separated mostly by three to four puncture widths, surface dulled by fine reticulotransverse shagreening; terga 3 and 4 similar to 2 but interband zone punctures denser and apical area absent on fourth; pygidial plate V-shaped, longer than broad, rounded apically; gradulus of tergum 6 with lateral parts absent.

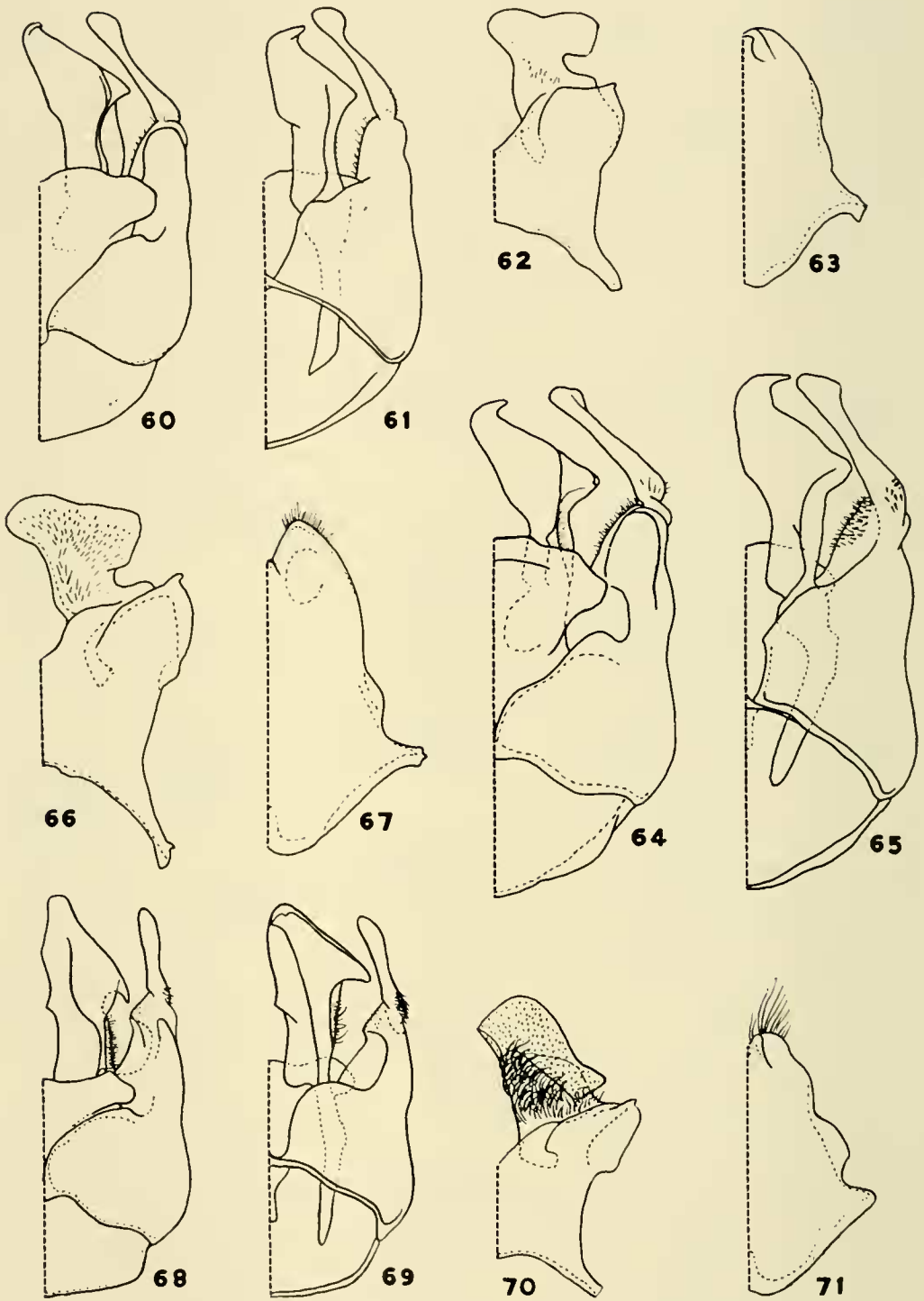
Hair: Head white with abundant brown on vertex. Thorax white laterally and posteriorly; scutellum dark brown fringed with white; mesoscutum ochraceous with posteromedian dark brown patch more than twice size of scutellar dark area; tegulae without brown. Metasomal tergum 1 pale ochraceous basally, with long subappressed simple brown hairs fringing posterior margin of glabrous apical area; tergum 2 white basally, interband zone and apical area with abundant, appressed to subappressed, simple, dark brown hairs, distal pale band absent; tergum 3 with basal tomentum dark brown, distal pale band present, of ochraceous pubescence, subequal to apical area in length medially, and not reaching apical margin at sides, interband and apical areas as in tergum 2; tergum 4 like 3 but pale pubescent band apical with small apicomedial triangular area with suberect brown hairs; terga 5 and 6 dark brown, sparse pale lateral hairs on fifth; sterna dark brown except white laterally. Legs white except as follows: inner surfaces tarsi bright golden yellow; outer-apical surfaces fore and middle tibiae and basitibial plates brown.

*Type Material.* The holotype female was collected April 8, 1922, at Carrefour, Haiti, and is in the collection of the American Museum of Natural History, New York City.

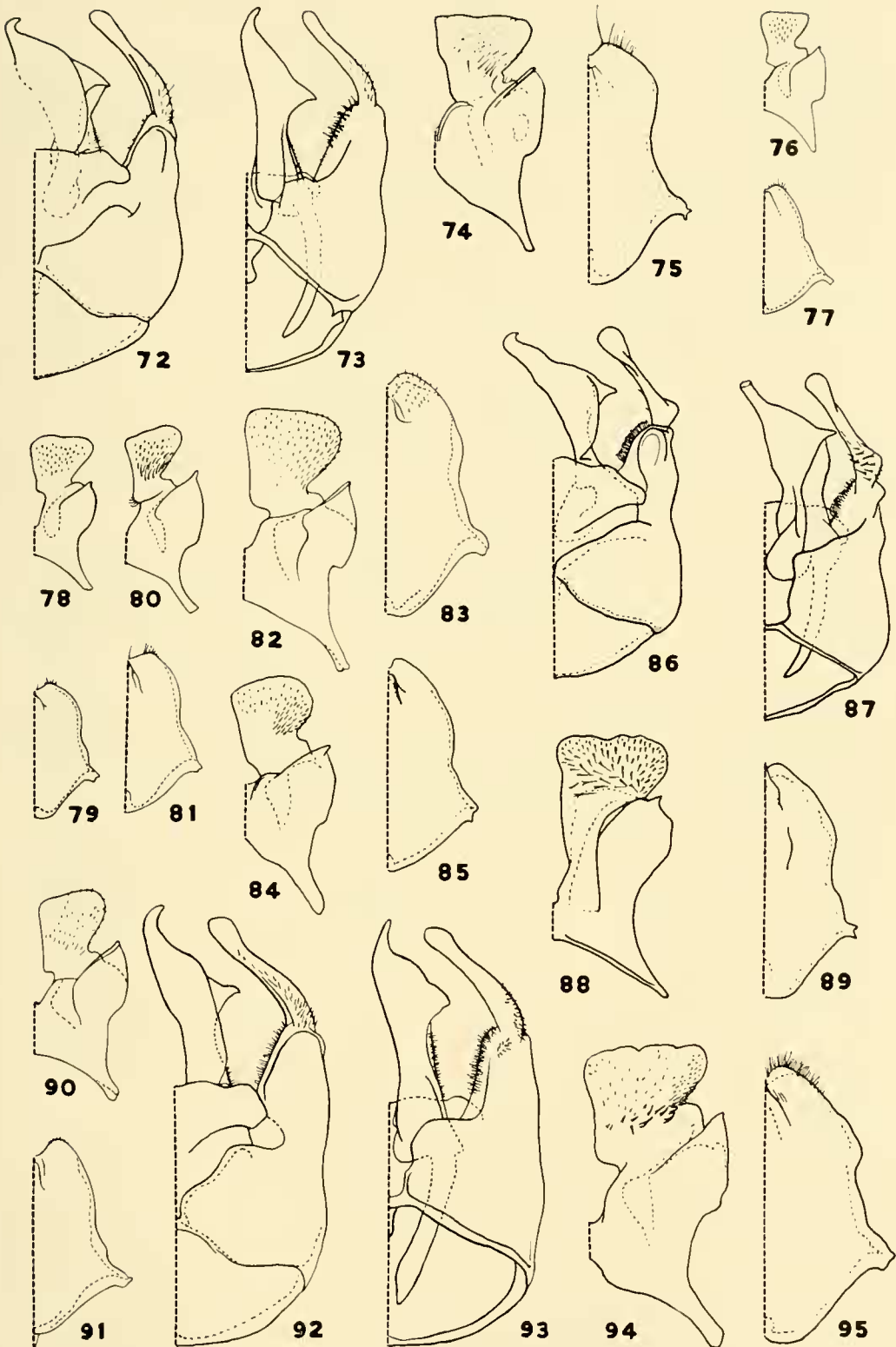


FIGS. 38-59. Male terminalia, approximately  $\times 29$ . Subgenus *Callimelisodes*. 38-57. Genital capsules (dorsal and ventral views) and sterna 7 and 8 (ventral views) as follows: 38-41. *M. lupina*. 42-45. *M. plumosa*. 46-49. *M. metenua*. 50-53. *M. clarkiae*. 54-57. *M. nigracauda*. 58. Sternum 7 of *M. composita*. 59. Sternum 7 of *M. lustra*.

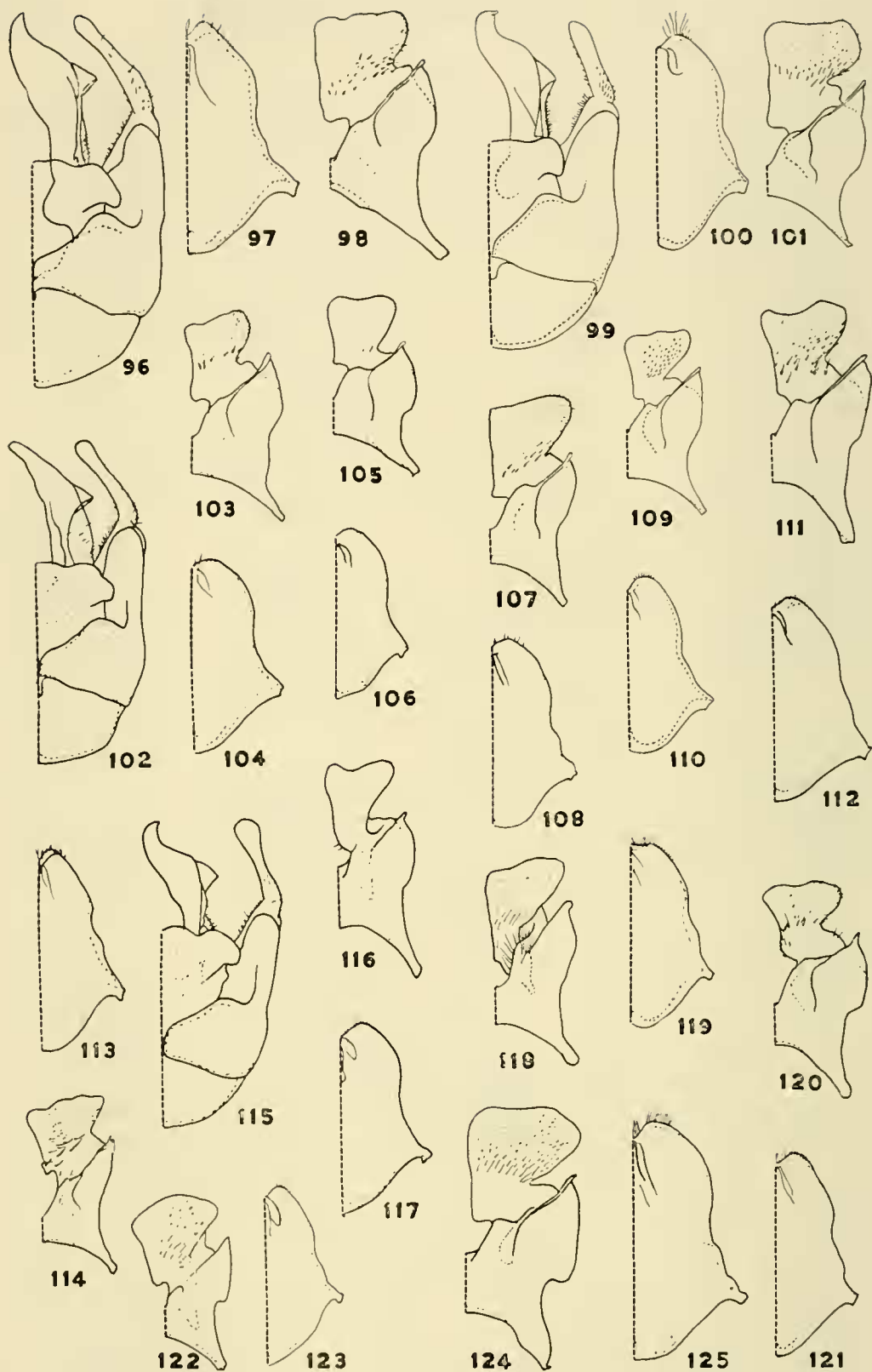




FIGS. 60-71. Male terminalia, approximately  $\times 36$ . Subgenus *Callimelissodes*. Genital capsule (dorsal and ventral views) and sterna 7 and 8 (ventral view). 60-63. *M. gleuwoodensis*. 64-67. *M. coloradensis*. 68-71. *M. stearnsi*.



FIGS. 72-95. Male terminalia, 76-81 and 90-91 approximately  $\times 17.5$ , all others approximately  $\times 36$ . Subgenus *Eumelissodes*. When four figures are indicated they are genital capsule (dorsal and ventral views) and sterna 7 and 8 (ventral views); if two figures are indicated, they are sterna 7 and 8. 72-75. *M. agilis*. 76-77. *M. trinodis*. 78-79. *M. bidentis*. 80-81. *M. dentiventris*. 82-83. *M. snowii*. 84-85. *M. boltoniae*. 86-89. *M. tristis*. 90-91. *M. fumosa*. 92-95. *M. vernoniae*.



FIGS. 96-125. Male terminalia, approximately  $\times 31$ . Subgenus *Eumelissodes*. When three figures are indicated they are genital capsule (dorsal view) and sterna 7 and 8 (ventral views); if two figures are indicated, they are sterna 7 and 8. 96-98. *M. pallidesignata*. 99-101. *M. subillata*. 102-104. *M. subagilis*. 105-106. *M. humilior*. 107-108. *M. verbesinarum*. 109-110. *M. utahensis*. 111-112. *M. brevipyga*. 113-114. *M. vernalis*. 115-117. *M. microsticta*. 118-119. *M. paulula*. 120-121. *M. personatella*. 122-123. *M. melanura*. 124-125. *M. moorei*.



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# INDEX

Those names now known to be synonyms, homonyms, or *nomina dubia* are marked with asterisks.

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